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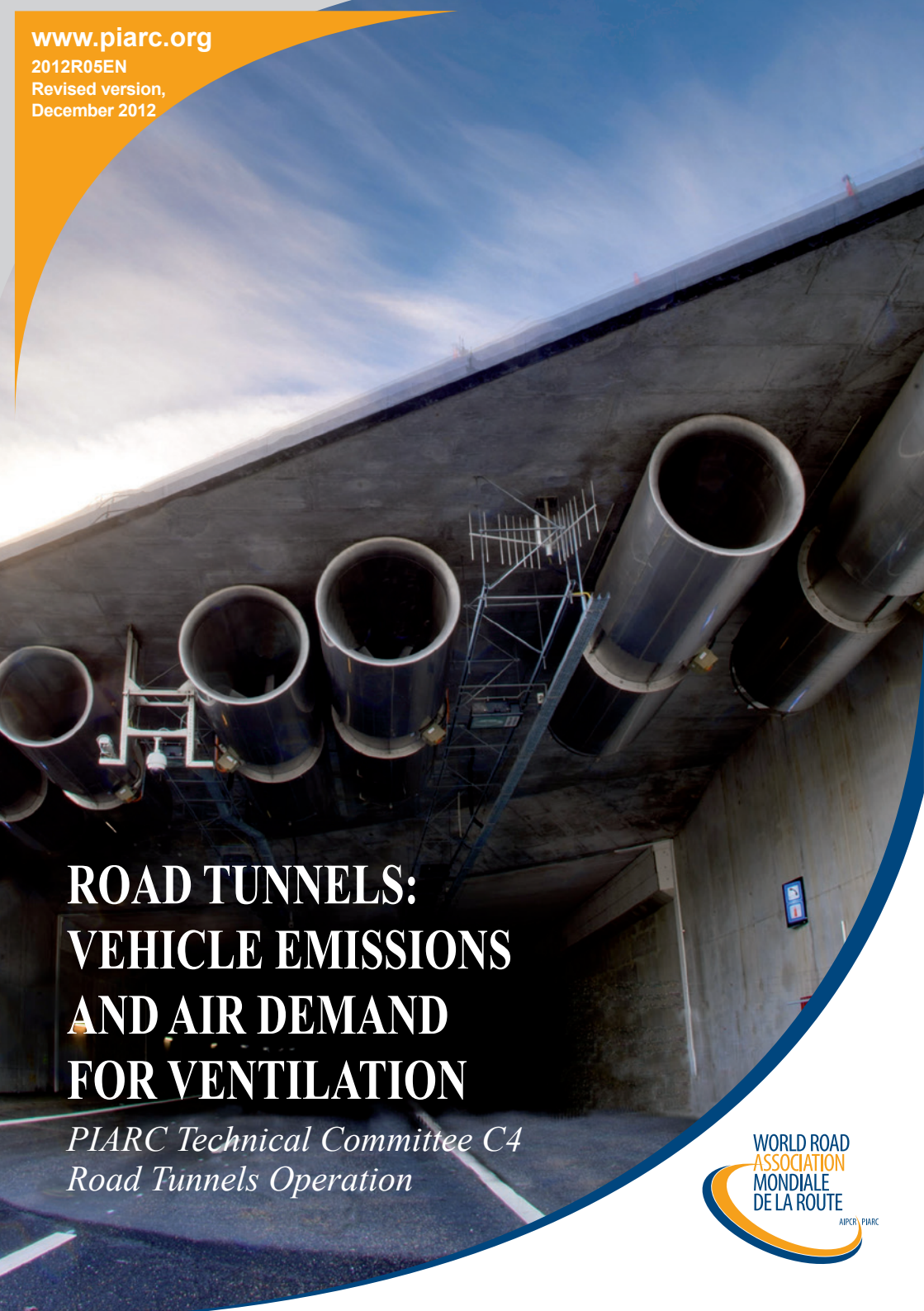

ROAD TUNNELS: VEHICLE EMISSIONS AND AIR DEMAND FOR VENTILATION

PIARC Technical Committee C4
Road Tunnels Operation

WORLD ROAD ASSOCIATION
MONDIALE DE LA ROUTE
AIPCR PIARC

STATEMENTS

The World Road Association (PIARC) is a nonprofit organisation established in 1909 to improve international co-operation and to foster progress in the field of roads and road transport.

The study that is the subject of this report was defined in the PIARC Strategic Plan 2008 – 2011 approved by the Council of the World Road Association, whose members are representatives of the member national governments. The members of the Technical Committee responsible for this report were nominated by the member national governments for their special competences.

Any opinions, findings, conclusions and recommendations expressed in this publication are those of the authors and do not necessarily reflect the views of their parent organizations or agencies.

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SUMMARY

The design of a ventilation system is based on two ventilation scenarios. One is the consideration of normal operation and the other consideration of a fire case. While the fire case is often the dominating factor for highway and non-urban tunnels, in tunnels with a high traffic load and frequent congested traffic, the fresh air requirement for normal operation can be dominant. This report aims at defining the minimum air requirement that is required to ensure adequate in-tunnel air quality and visibility thresholds.

The emission standards for new vehicles are becoming more stringent and the vehicle fleet is constantly being renewed. Therefore, the data for calculating vehicle emissions and subsequently the air demand must also be updated. This report provides the emission factors for exhaust pollutants such as CO, NO_x and PM, as well as the appropriate factors for non-exhaust particle emissions for passenger cars, light vehicles, and heavy-goods vehicles.

Within the last years many international programmes have been undertaken to extend the existing database for emission factors for road vehicles by updating the data for existing vehicles and by adding factors for vehicles in accordance with the upcoming emission standards. From this database, factors representing driving situations in road tunnels were depicted and a data set for ventilation design was developed. This dataset is intended for ventilation design purposes and differs from emission data used for environmental assessments, as a safety margin is added to take a certain proportion of high emitting vehicles into account.

Data collection and methodologies to derive fresh air volumes are similar to those described in previous reports of the World Road Association concerning the emission estimations for ventilation design. However, the older reports are outdated in terms of the usability of the emission factors as vehicle legislation has enforced much more stringent emission factors, and due to changes in technology.

This report completely replaces and completes the previous report entitled: *"Road tunnels: vehicle emissions and air demand for ventilation"* published in 2004 by the World Road Association (reference 05.14.B). It is strongly recommended to use this report for calculating the air demand in road tunnels.

INTRODUCTION

Tunnel ventilation systems must be able to provide adequate air quality during normal operation in addition to supporting self evacuation and rescue efforts during emergency incidents. This report focuses on establishing the road tunnel ventilation capacity for normal operation. The tunnel ventilation capacity requirements for emergency ventilation (typically during fires) must also be reviewed and compared to the normal operation requirements during the design of a tunnel ventilation system.

The ventilation capacity for normal operation is defined by the air demand required to dilute vehicle emissions to maintain allowable in-tunnel air quality values.

Due to the continual renewal of the vehicle fleet, a steady tightening of emission laws and the introduction of alternative propulsion systems (hybrid vehicles, electric cars, etc.) design emissions data needs constant updating. In this publication, new design information and references are provided for calculating the required capacity of mechanical ventilation systems for normal operation. The emission factor data base was updated for existing road vehicles and extended for vehicles following future emission standards to allow for emission projections for future years. The data originates mainly from tests on chassis dynamometers and the application of on-board measurement devices and is intended to describe the real-world emission behaviour of on-road vehicles in road tunnels.

This report entirely replaces the 2004 05.14.B PIARC report *"Road Tunnels: Vehicle Emissions and Air Demand for Ventilation"* [1] in terms of emission factors and related data. Regarding general definitions and methodology, the PIARC reports 2004, 05.14.B [1] and 1995, 05.02.B [2] are referenced.

The main changes since the previously published report [1] concern new emission data up to the year 2030, including the new emission standards EU 5 and EU 6. Light-Duty vehicles (LDV) are also considered.

The calculation scheme offers two possibilities for estimating vehicle emissions for a certain design year. One approach is based on a simple methodology using 2010 as the base year adjusted with country specific influencing factors concerning different design years, emission standards, etc. The second method allows a detailed emission calculation based on vehicle-specific emission factors. However, for this method, the detailed fleet composition for the design year is required.

The emission factors given in this document serve calculation design purposes. Therefore, they tend to be conservative in terms of emissions quantities.

A large uncertainty is related to the quantification of non-exhaust particulate matter (PM) emissions (re-suspension of road dust, abrasion).

1. TUNNEL AND TRAFFIC DATA

For important tunnel projects, each possible traffic situation must be defined by the traffic planner. The main points to be considered are:

Uni- or bi-directional traffic: The direction of traffic, uni- or bi-directional, influences the design ventilation capacity due to the influence of grade on emissions predictions. In some cases, a primarily unidirectional tunnel can occasionally be operated bi-directionally during maintenance periods. The projected number of reversed lanes and the traffic density must be determined in this case.

Design-year: The design-year of a tunnel-ventilation system is often the opening year, but the ventilation design year may be up to 10 or more years later when greater traffic numbers are expected. The traffic composition and its average emission must be assumed for the ventilation design year.

Traffic density (D): Projected traffic density and tunnel operations are key parameters. Projected traffic conditions such as the frequency of congested conditions (traffic lanes at peak capacity) or low vehicle counts, can influence the ventilation capacity. Traffic density per lane is calculated according to equation 1 (see below).

Congested and stopped traffic: Vehicle speeds around 10 km/h and stopped traffic typically define the normal ventilation capacity requirements. In longer tunnels, the ventilation equipment may be oversized if congested/stopped traffic is assumed over the entire tunnel length. Therefore, it is advisable to prevent congested/stopped traffic over the full tunnel length by a traffic control system.

Traffic speed (v): Usually the traffic speed in the tunnel is restricted by law. On a grade, trucks operate at a reduced speed. The range is indicated in *table 1*. The higher values represent the speed of newer trucks, the lower values represent those of older trucks (e.g. emission standard Euro 1 (1994) and older). Note that also the speed of Light-Duty vehicles might be influenced by positive road gradients.

TABLE 1 - MAXIMUM SPEED OF HGVS AS A FUNCTION OF ROAD GRADIENT

	Downhill				Uphill		
Gradient	- 6%	- 4%	- 2%	0%	2%	4%	6%
Vehicle Speed [km/h]	35 – 60	40 – 80	70 – 100	80 – 100	70 – 90	40 - 70	35 – 60

Peak traffic flow: The maximum traffic throughput per lane can occur at velocities around 60 km/h, depending on whether it is a rural or an urban traffic tunnel. Average peak values are given in table 2. In a heavily used urban tunnel, peak values in fluid traffic may be 10 to 20% higher. The hourly free flowing daily peak traffic volume is generally about 10% of the daily average traffic volume. In many cases, peak traffic is defined as the 30th largest trafficked hour per year. With little daily traffic, the capacity of the lane will not be used. Under certain circumstances, the numbers given in *table 2, following page,* can be exceeded.

Vehicle fleet: For emission calculations, it is necessary to split the vehicle fleet into relevant groups: passenger cars (PC), Light-Duty vehicles (LDV) and heavy-goods vehicles (HGV). Very often, the number of HGVs is given as a percentage of the total traffic volume. In addition, the heavy-duty fleet age distribution may vary depending on the type of traffic. On international routes (long haul traffic) more modern vehicles are typically used, while for local distribution traffic in urban areas, older vehicles are typical.

Passenger cars (PC): Passenger cars (PC) can be powered by gasoline or diesel engines.

Light-Duty Vehicles (LDV): This category concerns vehicles with a mass of typically up to 3.5 t. If possible, this vehicle class should be considered separately as they have different certification limits compared to PC and HGV.

Trucks, buses, heavy-goods vehicles (HGV): The number of trucks and buses, especially those powered by diesel engines, must be known for emission calculations. Often these data are given as an average percentage of the total traffic flow, but this value is normally too high when applied to peak traffic flow. The emission data provided in this document is for an average truck (fleet averaged combination of single lorries, lorry – trailer combination and semi-trailer). Mass-dependent factors are given for light trucks (15 t) and semi-trailers (32 t). In the context of this report, trucks and buses are referred to as heavy-goods vehicles (HGV). HGVs could be single trucks, lorry–trailer combinations, articulated trucks/semi-trailers or buses. Buses and coaches can be treated as light trucks (15 t).

Passenger car units (pcu): Vehicles vary greatly in size and shape. The pcu represents an average vehicle that can be used to determine the maximum number of vehicles that can use the tunnel at the same time. One passenger car corresponds to one pcu. For the purposes of converting a truck/bus into pcu, the HGV may be assumed to occupy the space of 2 passenger cars in free flowing traffic and up to 3 passenger cars in slow moving traffic, including uphill grades. With a given HGV percentage “a”, the vehicle density per lane km “D” is:

Equation 1: $$D_{uvp}[uvp/km] = D_{veh}[veh/km] \cdot \left[\left(1 - \frac{a}{100}\right) + \frac{a}{100}(2 \grave{a} 3)\right]$$

TABLE 2 - AVERAGE PEAK TRAFFIC DATA

		Average peak traffic density (pcu/km) Traffic flow (pcu/h) per lane			
		RURAL TUNNEL			
		Unidirectional traffic		Bi-directional traffic	
	v [km/h]	uvp/km	uvp/h	uvp/km	uvp/h
Fluid traffic	60	30	1,800	23	1,400
Congested traffic	10	70	700-850	60	600
Standstill	0	150	-	150	-
		URBAN TUNNEL			
		Unidirectional traffic		Bi-directional traffic	
	v [km/h]	uvp/km	uvp/h	uvp/km	uvp/h
Fluid traffic	60	33	2,000	25	1,500
Congested traffic	10	100	1,000	85	850
Standstill	0	165	-	165	-

Emission-laws (emission standards): Emission laws and their implementation vary from country to country. The emission factors used for the calculation must be matched to the emission standards of the individual model years of the vehicles.

2. ADMISSIBLE IN-TUNNEL CONCENTRATIONS OF TOXIC GASES

2.1 INTRODUCTION

Carbon monoxide CO is traditionally taken as the reference emission for the assessment of the toxicity of exhaust gases. The concentration of diesel-smoke as well as of non-exhaust particle emissions is the reference for visibility in the tunnel.

In some countries, nitrogen dioxide NO_2 is also taken into account regarding the in-tunnel air quality. For environmental reasons, the ambient air quality at the tunnel portals often has to adhere to certain thresholds of NO_2. Consequently, the requirements for in-tunnel air quality or ambient air quality at the tunnel portals may determine the capacity requirements of the ventilation system.

For pollutants affecting human health, time-dependent threshold values can be imposed whose aim is to consider the pollution dosage depending on the travel time required to pass through the tunnel.

Different design values are used to determine the capacity of the ventilation system. These include normal operations from projected traffic numbers and congested traffic. However, the control of the ventilation system is conducted according to set points that normally do not depend on traffic conditions. Set points are generally lower than the design ventilation capacity and selected so that design conditions are not exceeded even considering the time-lag effects of the traffic conditions on the ventilation system. Additionally, threshold values that should never be exceeded are defined for safe operation of the tunnel.

2.2 CARBON MONOXIDE CO

For the maximum design conditions, *table 3, page 16,* gives CO design values for various traffic situations. The 100 ppm value corresponds to the WHO recommendation for short term-exposures [3]. To avoid excessive air demands for rarely occurring congestion conditions, a higher CO-concentration can be allowed.

2.3 NITROGEN OXIDES NO_X

Nitrogen oxide (NO) and nitrogen dioxide (NO_2) are pollutants resulting from the combustion of fossil fuels. Most of the emitted nitrogen oxides (NO_x) consist of NO, which is oxidised into NO_2 in the presence of oxygen (especially ozone, O_3). NO by itself is not considered a harmful pollutant at commonly encountered levels. On the other hand, NO_2 is noxious and can irritate the lungs and lower the resistance to respiratory infections such as influenza.

While in previous years NO_x from combustion processes contained mostly NO (90 to 95% of the NO_x), the implementation of diesel vehicle exhaust gas after-treatment systems (oxygenation catalyst, DPF[1], SCR[2] systems) tend to significantly increase the primary emitted NO_2 percentages [17].

In many European road tunnels, NO_2 can be around 20 to 30% of NO_x concentrations, which strongly depends on the share of diesel vehicles with exhaust gas after-treatment systems in the vehicle fleet and on the residence time of the NO_x in the tunnel air. Only in tunnels with very few passenger cars with diesel engines will the NO_2 contribution remain below 10%.

[1] Diesel Particle Filter
[2] Selective Catalytic Reduction

The NO_2 levels in urban areas vary according to the season, temperature and time of day. In areas with intense traffic, one-hour peak levels can exceed short-term air-quality standards. Background levels of NO_x have to be determined carefully if this pollutant is considered in the ventilation design.

2.4 PARTICULATE MATTER (PM) EMISSIONS AND VISIBILITY

2.4.1. Visibility and light extinction

The presence of particulates leads to reduced visibility inside the tunnel. The consideration of visibility criteria in the design of the tunnel ventilation system is required due to the need for visibility levels that exceed the minimum vehicle stopping distance at the design speed. There are two primary sources of PM in a tunnel, exhaust emissions and non-exhaust emissions. Exhaust emissions consist of PM emanating from the tailpipe as a result of fuel combustion. Non-exhaust PM consists of tyre and brake wear, road surface abrasion and re-suspended dust.

Visibility is reduced by the scattering and absorption of light by PM suspended in the air. The amount of light scattering or absorption is highly dependent upon the material, diameter of the particle and particle density. The principle for measuring visibility in a tunnel is based on the fact that a light beam decays in intensity as it passes through air. The level of decay can be used to determine the opacity of air. Opacity meters for tunnels typically use these effects to measure visibility within the tunnel. This process is described by the formula:

Equation 2: $E = E_0.e^{-KL}$

Where "E_0" is the light source (or emitter) intensity, "E" is the light receptor intensity and "L" is the distance between the emitter and receptor expressed in meter. "K" is the extinction coefficient and is expressed in 1/m.

In tunnel ventilation, it has become customary to express visibility by the extinction coefficient K. Extinction is defined as the loss of intensity E - E_0 after travelling the distance L through the tunnel air relative to the source strength E_0. According to Equation 3, the extinction coefficient is expressed as:

Equation 3: $K = - 1/L \, . \, ln(E/E_0)$

Alternatively, visibility can also be represented by transmission "S". Transmission is the percentage of beam intensity "E" that is lost relative to the source strength E0 after travelling the distance "L". It is defined on the basis of Equation 4:

Equation 4: $S\,(\%) = 100 \, . \, e^{-KL}$

The extinction coefficients used for the design of the ventilation system are given below:

- K = 0.003 m^{-1} means clear tunnel air (visibility of several hundred meters)
- K = 0.007 m^{-1} approximates a haziness of the tunnel air and
- K = 0.009 m^{-1} approximates a foggy atmosphere.
- K = 0.012 m^{-1}, threshold value which should not be exceeded during operation and which results in a very uncomfortable tunnel atmosphere. However, there is normally enough visibility for a vehicle to stop safely at an obstacle.

Strong fluctuations in visibility can occur e.g. when several diesel-trucks move as a group, when some unusually smoky vehicles are in the tunnel, or when the ventilation control reacts too slowly to emission peaks.

2.4.2. Exhaust emissions

Vehicle exhaust consists of very small particles mainly in the range of 0.01 to 0.20 µm. Particles in this range are very effective in light extinction. Diesel combustion is the main source of combustion-related particle emissions. Therefore HGVs and PCs with diesel engines are the primary contributors to PM in exhaust emissions. Diesel particle filters (DPF) strongly reduce these emissions in terms of mass as well as the number of particles. Recent studies indicate that gasoline-powered vehicles with direct fuel injection also contribute to particulate-matter (PM) emissions. In this document, these small contributions are neglected. These studies have resulted in the introduction of a PM standard for new technology gasoline vehicles (e.g. Euro 5).

2.4.3. Non-exhaust PM emissions

In addition to tailpipe emissions, vehicles also emit particulate matter due to abrasion processes (road, tires, brake wear, etc.) and re-suspension of road dust. These types of emissions occur for all vehicles and are not restricted to the use of internal combustion engines as the propulsion system.

Non-exhaust particle emissions are mainly in the size from 1 µm and upwards. Hence, they contribute strongly to $PM_{2.5}$ and even more to PM_{10} concentrations, but less to light extinction [1]. While the abrasion processes correlate with driving behaviour and vehicle speed, the quantity of suspended particles is strongly related to the cleanness of the tunnel and the traffic mode (uni- or bi-directional traffic).

2.4.4. Particle emissions and visibility / extinction factor

The reason for reduced visibility is light extinction by the scattering and absorption of radiation in the visible wave-length range. In general, sulphates, nitrates, organic

compounds, soot and soil are the major components that scatter and absorb light in the atmosphere. Except for mineral based re-suspended and abrasion particles, most of these components are abundant in the size range up to 0.7 µm. This is approximately the wave length of visible light. Due to the similarity between wave length and particle diameter, there is a significant effect on visibility impairment [4]. In road tunnels, the two source types of emission, *"exhaust"* and "*non-exhaust"*, are relevant. Although both fractions have different extinction behaviour and therefore should be treated differently, the following correlation between exhaust and non-exhaust $PM_{2.5}$ mass concentration (µ in mg/m³) and light extinction (K in m^{-1}) can be applied for diluted exhaust gases [1]:

Equation 5: *Diluted exhaust gas (tunnel): $K = 0.0047\ \mu$*

2.5. DESIGN AND THRESHOLD VALUES FOR VENTILATION SIZING

2.5.1. Definitions

Design Value: The required capacity of the tunnel ventilation system is determined by the application of design values as defined in this report.

Set points: Set points are used for the operation of the tunnel ventilation system. These are different from the design values and normally do not differ with variations to traffic conditions. Set points are generally lower than the design values and are selected so that design conditions are not exceeded even considering the time-lag effects of the traffic conditions on the ventilation system.

Threshold values: For safe operation of the tunnel, threshold values are defined that may not be exceeded i.e. if reached an immediate action (e.g. tunnel closure) has to be taken.

The application of overly stringent design values might result in severe over-sizing of the ventilation system. Moreover, threshold values or set points that are too low can cause excessive operational costs.

2.5.2. CO and visibility

Table 3, following page, gives the design and threshold values proposed for CO and visibility. The design values are for design purposes and not for tunnel operation (i.e. not set points).

TABLE 3 - DESIGN AND THRESHOLD VALUES FOR CO AND VISIBILITY/ EXTINCTION			
Traffic situation	**CO**	**Visibility**	
		Extinction coefficient K	**Transmission s (beam length: 100 m)**
	ppm	**10^{-3} m^{-1}**	**%**
Free flowing peak traffic 50 – 100 km/h	70	5	60
Daily congested traffic, stopped on all lanes	70	7	50
Exceptional congested traffic, stopped on all lanes	100	9	40
Planned maintenance work in a tunnel under traffic*	20	3	75
Threshold values for closing the tunnel**	200	12	30
* National workplace guidelines have to be considered ** The values given here are for tunnel operation only and not for determining ventilation capacities.			

Some countries impose 50 ppm for CO and a K value of 0.005 m^{-1} as design values for peak flow as well as for daily congested traffic. Widely used values for tunnel design are 70 to 100 ppm for CO and 0.007 m^{-1} for K.

2.5.3. NO_2

Threshold values for NO_2 might be imposed due to two different reasons. One is to protect the environment close to the portals or at stack outlets. The second is to protect tunnel users. In the first case, ambient air quality analyses are usually performed to assess the impact of emissions emanating from the ventilation exhaust points (tunnel portals or at stack outlets) to locally sensitive receptors. Where sensitive receptors are near the ventilation exhaust points, increasing the ventilation airflow rate can enhance emission dilution.

Results of studies in which people have been exposed to NO_2, have demonstrated that this gas can negatively affect healthy people as well as sensitive people, however, sensitivity levels are very different. For healthy people, effects have been noted for peak levels higher than 4,000 µg/m³; no effects have been observed for peak levels below 2,000 µg/m³ [5]. Based on these findings, PIARC proposed an in-tunnel air quality level of 1 ppm NO_2 [5] as an average value.

Some countries have introduced values for different time frames. For very short time considerations, France adopted the WHO threshold value and proposes 0.4 ppm (as

an average over 15 min). However, the WHO limit aims at improving the air-quality in general and is not intended to be applied as peak exposure. Based on recent studies, Sweden is currently in the process of abandoning the WHO threshold as in-tunnel air-quality limit [15]. The experimental study by Langrish et al [14] showed that a 4 hr exposure to 8,000 µg/m³ did not give any significant vascular effect by the participants. Belgium applies 1,000 µg/m³ (as an average over 20 min) and Norway 1.5 ppm (as an average over 15 min) [16] as the limiting concentration inside a tunnel.

Many countries do not apply a limit to NO_2 for tunnel users but the short-time working exposure limit (e.g. 3.0 ppm in Switzerland, 5 ppm as US NIOSH standard) implicitly applies.

As a tunnel passage generally only lasts a few minutes, stringent NO_2 threshold values should only be considered either in combination with traffic conditions and/or ambient conditions at the ventilation outlets.

Where the tunnel ventilation system is also dimensioned for NO_2, it is proposed to permit an average in-tunnel concentration of 1.0 ppm NO_2 along the length of the tunnel at any one time as the design value. A threshold value for a short-time working exposure limit may also be applicable.

2.6. AMBIENT AIR CONCENTRATION (C_{AMB})

Ambient air supplied to the tunnel as fresh air contains background levels of CO, NO_2 and PM. These background levels are normally relatively low, but they should be checked, particularly in the case of urban tunnels. Typical values of CO range between 1 to 5 ppm. Likewise, concentrations of NO_2 up to 200 µg/m³ are typical peak values, but can be exceeded in dense urban areas.

The situation is aggravated further when air from the portal of one bore re-circulates and enters the portal of the adjacent bore as *"fresh air"*. Simple structural design features such as barrier walls between portals could be applied to minimize or avoid recirculation of tunnel air. Thus the safety level of the tunnel can be enhanced.

2.7. MINIMUM AIR EXCHANGE

In tunnels with mechanical ventilation, the minimum air exchange rate is determined using design values. Where traffic volumes are low, the minimum fresh air requirement might be quite small. However, the ventilation system should be able to accommodate sudden demands such as for high emitting HGVs.

For such cases, an air-exchange rate of at least 4 times per hour should be considered. Where longitudinal ventilation systems are provided, a minimum longitudinal air velocity of 1.0 to 1.5 m/s is recommended to be used as a design criterion.

3. EMISSIONS

3.1. GENERAL REMARKS

The introduction of emissions legislation has resulted in emissions reductions as new, lower emitting vehicles replace older, higher emitting vehicles. Worldwide emission standards for Europe, Japan and the USA dominate the emissions legislation. As emission standards define the threshold values according to a specific test procedure and apply only for new vehicles, real world vehicle emissions differ strongly from the values given in the vehicle-emission standards.

The aim of this document is to provide genuine world emission factors for tunnel ventilation design on an international basis. This section contains emission factors for various regions all over the world for the base year 2010 and reduction factors for emission projections until 2030. Emission factors specifically derived for certain regions/countries should always be given preference.

The base data referring to the individual EURO-Standards is given in the appendix. PIARC data was derived from available emission data from "*the emission factor handbook version 3.1"* [6] and adjusted to account for in-tunnel driving behaviour. Factors given in HBEFA V3.1 have been derived for different European countries. All these countries require vehicles to be checked regularly for technical issues, including exhaust emissions. For countries that don't adopt any regular checking procedures, a distinction into standard B or C can be made.

3.2. EMISSION STANDARDS

The EC EURO-standards have been implemented in Europe, in many countries of Asia (except Japan and South-Korea) and in a few countries in South America, Africa and the Arabic countries. A different regulation exists in North America, which is also in use in Central America, some countries in South America, as well as in South Korea.

Before using the emission tables given in *chapter 3.5, page 24,* the emissions legislation in the region should be reviewed, including the timing when legislation was applied and the legislative history of the country for emissions. The application of the emission standards to the local situation should be checked. Some countries have changed from one scheme to another, e.g. Argentina adopted the EURO standards in 2004 starting with EURO 2, Australia starting in 2004 with Euro 3, India in 2005 with Euro 2 (however Euro 3 was adopted in the 11 largest cities). Some countries have implemented emission standards but no effective emission-control system. In such cases, a downgrading to a lower emission standard B or C (i.e. higher emission levels) might be required. This somewhat complicates defining the appropriate emission factors for ventilation design.

Table 4 shows as an example the emission standards for passenger cars with gasoline engines valid for the European Union. Similar tables can be given for light-duty vehicles and for HGVs. Other regions might have different implementation years or different emission standards. Before using the emission factors given in this report, the user has to check and prove the usability of the factors for each individual project.

The situation concerning US emission standards is quite different. Since the NLEV and the TIER II regulation (model year > 2004), emission standards for single model years have been replaced by fleet-averaged emission values, depending on the various types of vehicles sold by one manufacturer.

TABLE 4 - EC EURO STANDARDS, EMISSIONS FOR PASSENGER CARS, GASOLINE

	Year of implementation	CO	HC	NO_x	HC+NO_x	Particles
		[g/km]				
ECE R 15/03	1979	21.5	1.8	2.5		smoke number
ECE R15/04	1982	16.5			5.1	smoke number
US 83*	1987	2.1	0.25	0.62	0.373	
PC Euro 1	1992	2.72			0.97	0.14
PC gasoline EURO 2	1997	2.2			0.5	
PC gasoline EURO 3	2000	2.3	0.2	0.15		
PC gasoline EURO 4	2005	1.0	0.1	0.08		
PC gasoline EURO 5	2008	1.0	0.100	0.060	0.068 (HCNM**)	0.005 (DI***)
PC gasoline EURO 6	2014	1.0	0.100	0.060	0.068 (HCNM**)	0.005 (DI***)

* Austria, Switzerland, Sweden,
** Non-Methane Hydro Carbons,
*** Direct Injection

3.3. FLEET SEGMENTATION

To calculate vehicle emission rates and fresh air demands, the vehicle fleet needs to be segregated into the following classes:

- passenger cars (PC) gasoline, PC diesel,
- light-duty vehicle (LDV) (if explicitly given and not included in PC),
- heavy-goods vehicles and buses (HGV).
- Proportion of vehicles using alternative fuels (alcohol, CNG) as a percentage of the various fleet segments.

Very often, traffic counts give information about the numbers of passenger cars, Light-Duty vehicles and heavy duty vehicles. If passenger cars and Light-Duty vehicles are grouped in the traffic data, a proportion of 10% of the number of passenger cars is a typical value for the LDVs.

3.4. CALCULATION PROCEDURE

3.4.1. General remarks

Generally, the calculation should be based on the projected vehicle-fleet distribution valid for the tunnel under consideration. Fleet differentiation should be undertaken for PCs, LDVs and HGVs depending on the proportion of vehicles according to the individual emission standards. Many of the national guidelines contain emission data for ventilation sizing (e.g.: [8], [9], [10]). In other countries, vehicle-emission models (e.g.: [6], [7]) might be used to calculate the emission of vehicles in tunnels.

If this data is not available, the calculation can be based on simplified predefined base-emission factors which are defined as functions of average technology standards for a certain region (see section 3.4.3).

3.4.2. Air demand

The required amount of fresh air for a given traffic condition in the tunnel depends on the number of vehicles in the tunnel, the average emission per vehicle, the admissible concentration for the particular emission and the ambient air concentrations:

Number of vehicles in tunnel:

Equation 6: *for v = 0 km/h* $n_{veh} = D_0 \bullet L$

for v > 0 km/h $n_{veh} = \frac{M \cdot L}{v}$

v	Vehicle speed [km/h]
n_{veh}	Number of vehicles in tunnel [-]
D_0	Traffic density for v = 0 km/h [pcu/km]
L	Length of tunnel [km]
M	Traffic volume [pcu/h]

(see table 2, page 11)

The fresh air demand required is calculated as the maximum of the air volumetric flow rates needed to dilute each of the contaminants. These air volumetric flow rates, for each contaminant, are obtained using equation 7 below adding up the individual contribution for each type of vehicle.

Equation 7: $\dot{V}_{cont} = \frac{\sum_{veh-type} (n_{veh-type} \cdot Q_{cont}^{veh-type})}{(C_{adm} - C_{amb})}$; (cont : CO , NO_x , PM), (veh – type : PC - gas, PC - diesel, LDV, HGV)

For the opacity due to diesel smoke and non-exhaust PM, (C_{adm} - C_{amb}) is replaced by K_{adm}.

$\dot{V}_{cont}$	Air volume flow rates for each type of contaminant [m³/h]
$n_{veh-type}$	Number of vehicles in tunnel for each type [-]
$Q_{cont}^{ven-type}$	Emission for CO, NO_X [g/(h.veh)] and emissions of particle matter [m²/(h.veh)]
C_{adm}	admissible concentration of each type of pollutant (CO, NO_x) [g/m³]
C_{amb}	ambient (background) concentration of each type of pollutant (CO, NO_x) [g/m³]
K_{adm}	admissible extinction coefficient [m-1]

For example, in the case of CO, the required air volume flow for its dilution is determined by:

$$\dot{V}_{CO} = \frac{n_{PC-gasoline} \cdot Q_{CO}^{PC-gasoline} + n_{PC-diesel} \cdot Q_{CO}^{PC-diesel} + n_{LDV} \cdot Q_{CO}^{LDV} + n_{HGV} \cdot Q_{CO}^{HGV}}{C_{adm} - C_{amb}}$$

Where:

$\dot{V}_{CO}$	Air volume flow [m³/h] necessary for CO dilution
$n_{PC\text{-}gasoline}$	Number of passenger car vehicles with gasoline engines in tunnel [-]
$n_{PC\text{-}Diesel}$	Number of passenger car vehicles with diesel engines in tunnel [-]
n_{LDV}	Number of light duty vehicles in tunnel [-]
n_{HGV}	Number of heavy good vehicles in tunnel [-]
$Q^{PC\text{-}gasoline}{}_{CO}$	Passenger car with gasoline engines emission for CO [g/(h.veh)]
$Q^{PC\text{-}diesel}{}_{CO}$	Passenger car with diesel engines emission for CO [g/(h.veh)]
$Q^{LDV}{}_{CO}$	Light-duty vehicle emission for CO [g/(h.veh)]
$Q^{HGV}{}_{CO}$	Heavy-goods vehicle emission for CO [g/(h.veh)]
C_{adm}	Admissible concentration of CO [g/m³]
C_{amb}	Ambient concentration of CO [g/m³]

3.4.3. Simplified method

If emission data for the project cannot be provided by a locally valid data base, the following simplified calculation method can be applied to calculate the emission rate "Q". Currently, base emission factors and influencing factors are available for the following categories defined by emission technology standards:

Technology standard A
This technology standard describes the emission behaviour of a single average vehicle following the EU emission legislation concerning emission standards and years of implementation of these standards. It covers the European Union, USA and countries with similar vehicle emission standards.

For the purpose of determining tunnel ventilation capacities, Euro and US emission standards can be treated as almost similar for the same model year. Note that for environmental assessment studies, specific country dependent emission factors have to be used. The relevant emission values are given in *chapter 3.5, page 24.*

Technology standard B
Standard B is used for countries which have adopted Euro or similar emission standards with a time shift of 10 years. The emissions can be calculated on the basis of the emission factors for technology standard A times an influencing factor "fe". For further classification see chapter *3.6.2., page 33*.

Technology standard C
Standard C applies to countries which have adopted emission standards but don't conduct any effective emission control (i.e. vehicle inspection programs) of the ageing vehicles. The emissions can be calculated on the basis of the emission factors for technology standard A times an influencing factor "fe". For further classification see chapter *3.6.2., page 33*.

The base emission factors are given in the tables as a function of the average vehicle velocity in a tunnel, and of the road gradient. The values given for a vehicle speed of 0 km/h represent idling conditions.

The emissions are given per hour. By dividing the value with the corresponding vehicle velocity, the emission per km is obtained. To convert the emission given in grams (g) into a volumetric emission, the emission values have to be divided by the specific weight of the particular gas. Average values for standard atmospheric conditions are:

- $\rho_{CO} = 1.2\ kg/m^3$,
- $\rho_{NO2} = 1.9\ kg/m^3$.

Nitrogen oxide emissions (NO_x) in the car exhaust consists predominantly of NO which has a lower specific weight than NO_2. When giving NO_x-emission data by weight, it is the convention to express the NO_x volume as NO_2 in order to have comparable NO_x emission values.

The conversion factor between the particulate matter (PM) emission in mass (gram) to opacity is given by 1 g = 4.7 m² *(see chapter 2.4.4., page 14)*.

Corrective factors to be applied when determining the emission quantity
Altitude factor - fh: The altitude influence on the different exhaust components varies with the type of engine. Although the data base is poor, the altitude factor should be taken into account in a conservative manner so that adequate ventilation design is ensured. The factor has to be interpreted in relation to the base emission values given in the tables, i.e. a factor for the height of 2,000 m means that the base emission values of the tables have to be multiplied by the respective factor. Passenger cars with catalytic converters behave quite differently to cars without such converters.

Time factor - ft: As the base emission factors are given for the base year 2010, emission projections for future years are influenced by fleet renewal of vehicles with more stringent emission standards into account. This factor also includes the degradation of exhaust gas after-treatment systems during the life of a vehicle.

Mass factor for heavy goods vehicles - fm: The base emission quantities given for HGV are an average value for a typical fleet consisting of single lorries, trailer trucks and coaches, whereas coaches can be related to single lorries. The average vehicle mass accounts to 23 t and describes a mixture of single trucks and lorry-trailer combinations, both loaded and empty. As the emission quantity of HGV is strongly related to the total vehicle mass (including load), different vehicle masses have to be considered by using the vehicle mass factor. This factor is only applicable for HGVs.

Influence factor for technology standards - fe: When the emission factors given for technology standard A are applied for regions with differing emission standards, the appropriate factor has to be applied according to *section 3.6.2*.

3.4.4. Passenger cars (PC) and light-duty vehicles (LDV)

This calculation has to be performed for PCs with gasoline and PCs with diesel engines and for LDVs separately. The procedure is based on the following equation:

Equation 8: $Q = q_{ex}(v,i) \bullet fh \bullet ft \bullet fe + q_{ne}(v)$

where:

Q emission for CO, NO_X [g/(h.veh)] and emissions of particle matter [m²/(h.veh)]
$qex\ (v;\ i)$ base emission factor for PC/LDV with gasoline or diesel engines, depending on average speed and road gradient for the base year 2010 [g/(h.veh)] or [m²/(h.veh)]

qne (v) emission factor for non-exhaust particulate emissions *(see table 27 and 28, page 35)*, [m²/(h.veh)]
fh altitude factor [-]
ft influence factors years differing from the base year [-]
fe influence factor for other technology standards [-]

3.4.5. Heavy-goods vehicles, and buses with diesel engines (HGV)

The method for calculation of HGV specific emissions is similar to that for PCs. Contrary to the PC procedure, the emissions for heavy goods vehicles and buses (HGV) are almost proportional to the vehicle mass to be moved. Hence, the actual vehicle mass is included into the calculation.

Equation 9: $Q = q_{ex}(v,i) \bullet fh \bullet ft \bullet fe \bullet fm + q_{ne}(v)$

where:

Q emission for CO, NO_X [g/(h.veh)] and emissions of particle matter [m²/(h.veh)]
$q_{ex}(v, i)$ base emission factor for HGV with diesel engines, depending on average speed and road gradient for the base year 2010 [m²/(h.veh)]
$q_{ne}(v)$ emission factor for non-exhaust particulate emissions *(see table 27 and 28, page 35)*, [m²/(h.veh)]
fh altitude factor [-]
ft influence factors for years differing from the base year [-]
fe influence factor for technology standards [-]
fm influence factor for vehicle gross masses [-]

3.5. EMISSION FACTORS - BASE CASE: TECHNOLOGY STANDARD A

The following emission factors can be used as described, with a base year being defined as 2010. Deviations from that year have to be calculated using the appropriate factors for future emissions. The base emission factor represents an *'average'* vehicle on the road for the specific base year i.e. an *'average'* passenger car consists of a certain percentage of vehicles according to Euro 1, Euro 2, etc. emission standards. The detailed percentage is given in *table 5, following page*.

TABLE 5 - FLEET COMPOSITION USED FOR BASE CASE EMISSION FACTOR CALCULATIONS FOR TECHNOLOGY STANDARD A								
type	**year**	**pre EU1**	**EU 1**	**EU 2**	**EU 3**	**EU 4**	**EU 5**	**EU 6**
PC gasoline	2010	14.87%	3.95%	12.40%	20.87%	43.64%	4.27%	0.00%
PC Diesel		2.34%	1.75%	8.11%	32.70%	49.25%	5.85%	0.00%
LDV gasoline		36.20%	5.87%	14.31%	20.93%	22.68%	0.00%	0.00%
LDV Diesel		4.36%	1.97%	8.26%	37.80%	47.60%	0.00%	0.00%
HGV Diesel		4.07%	5.11%	16.08%	28.45%	12.07%	34.22%	0.00%

3.5.1. Passenger cars

Base emission factors

The base emission factor quantifies the vehicle specific tailpipe emission for a specific pollutant as a function of average vehicle speed and road gradient. The factor differs for gasoline and diesel fuelled cars.

TABLE 6 - BASE EMISSION FACTORS FOR CO (EC EURO REGULATION) GASOLINE PASSENGER CARS							
PC gasoline CO [g/h] 2010							
v [km/h]	**Gradient [%]**						
	- 6	**- 4**	**- 2**	**0**	**2**	**4**	**6**
0	20.5	20.5	20.5	20.5	20.5	20.5	20.5
10	24.4	25.9	27.8	29.5	32.0	35.5	42.9
20	28.3	31.4	35.2	38.6	43.6	50.5	65.4
30	28.2	32.9	38.9	46.0	54.6	64.6	87.4
40	28.0	34.5	43.5	56.2	71.7	93.2	120.4
50	27.4	35.5	46.9	63.0	85.4	118.0	163.2
60	27.1	36.0	49.4	68.2	97.5	140.2	221.6
70	26.9	36.3	51.7	75.0	113.2	169.4	290.2
80	26.7	37.1	54.9	85.5	136.6	217.7	369.1
90	27.8	39.4	60.1	99.6	170.3	297.4	483.3
100	32.5	45.2	69.2	117.2	218.1	422.2	643.6
110	44.2	58.0	86.2	143.0	291.6	612.1	1,007.4
120	67.2	83.8	119.4	192.7	419.4	889.8	1,615.2
130	106.4	132.0	183.5	303.1	660.7	1,333.0	2,462.1

TABLE 7 - BASE EMISSION FACTORS FOR NO_X (EC EURO REGULATION) GASOLINE PASSENGER CARS							
PC gasoline NO_X [g/h] 2010							
v [km/h]	Gradient [%]						
	- 6	- 4	- 2	0	2	4	6
0	1.6	1.6	1.6	1.6	1.6	1.6	1.6
10	3.3	3.3	3.3	4.4	5.1	5.7	6.3
20	3.3	3.3	3.4	5.3	6.2	8.9	12.4
30	3.3	3.3	4.0	6.0	9.1	13.2	15.3
40	3.3	3.3	4.3	6.7	12.1	15.3	17.6
50	3.3	3.3	4.4	8.1	13.9	17.0	19.5
60	3.3	3.3	4.9	10.3	15.7	18.8	23.8
70	3.3	3.3	5.6	13.3	17.5	21.7	29.7
80	3.3	3.3	6.7	15.1	19.3	27.0	36.4
90	3.3	3.3	9.9	17.0	22.7	32.9	43.8
100	3.3	4.3	13.7	19.0	28.4	40.1	52.4
110	3.3	6.2	16.1	22.8	35.1	48.3	62.2
120	3.3	10.9	18.5	29.1	43.0	57.8	73.3
130	3.7	15.0	22.4	36.8	52.2	68.6	85.7

TABLE 8 - BASE EMISSION FACTORS FOR CO (EC EURO REGULATION) DIESEL PASSENGER CARS							
PC Diesel CO [g/h] 2010							
v [km/h]	Gradient [%]						
	- 6	- 4	- 2	0	2	4	6
0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
10	2.2	2.2	2.2	3.6	5.1	6.7	8.4
20	2.2	2.2	2.4	5.4	8.2	4.1	3.2
30	2.2	2.2	3.0	7.2	4.0	3.3	3.2
40	2.2	2.2	3.2	8.6	3.1	3.3	2.8
50	2.2	2.2	2.9	6.3	3.3	2.9	2.6
60	2.2	2.2	3.4	4.0	3.3	2.7	2.6
70	2.2	2.2	4.6	3.2	2.9	2.4	3.1
80	2.2	2.2	6.6	3.4	2.7	2.8	3.6
90	2.2	2.2	7.8	3.2	2.5	3.2	4.2
100	2.2	2.2	5.2	2.8	2.8	3.8	4.8
110	2.2	2.6	3.4	2.5	3.3	4.4	5.5
120	2.2	6.9	3.1	2.7	3.8	5.0	6.2
130	2.2	3.5	2.7	3.2	4.5	5.7	7.0

TABLE 9 - BASE EMISSION FACTORS FOR NO_X (EC EURO REGULATION) DIESEL PASSENGER CARS							
PC Diesel NO_X [g/h] 2010							
v [km/h]	Gradient [%]						
	- 6	- 4	- 2	0	2	4	6
0	6.3	6.3	6.3	6.3	6.3	6.3	6.3
10	6.3	6.3	6.3	11.5	15.8	19.6	23.6
20	6.3	6.3	7.2	16.5	23.0	28.3	36.6
30	6.3	6.3	9.3	20.9	28.6	38.7	51.7
40	6.3	6.3	10.0	24.0	34.6	49.9	68.2
50	6.3	6.3	9.0	25.7	40.7	61.6	83.7
60	6.3	6.3	10.7	28.6	50.3	76.3	103.9
70	6.3	6.3	14.2	34.7	62.5	92.9	127.9
80	6.3	6.3	19.4	43.1	76.4	113.1	154.1
90	6.3	6.3	24.7	54.0	91.9	135.9	182.6
100	6.3	6.3	31.3	68.4	112.5	162.7	215.2
110	6.3	7.9	41.7	85.6	137.2	193.1	251.6
120	6.3	20.0	56.8	107.2	165.8	227.7	292.2
130	6.3	30.1	76.3	134.4	199.0	266.9	337.6

TABLE 10 - BASE EMISSION FACTORS FOR EXHAUST PARTICLES (OPACITY) (EC EURO REGULATION) DIESEL PASSENGER CARS							
PC Diesel Opacity [m^2/h] 2010							
v [km/h]	Gradient [%]						
	- 6	- 4	- 2	0	2	4	6
0	1.4	1.4	1.4	1.4	1.4	1.4	1.4
10	1.4	1.4	1.4	2.9	4.1	5.3	6.6
20	1.4	1.4	1.7	4.4	6.4	8.4	10.7
30	1.4	1.4	2.2	5.7	8.5	11.3	14.7
40	1.4	1.4	2.4	6.7	10.2	14.3	19.0
50	1.4	1.4	2.2	7.4	11.8	17.3	22.9
60	1.4	1.4	2.6	8.5	14.4	21.1	27.3
70	1.4	1.4	3.7	10.2	17.5	25.2	31.4
80	1.4	1.4	5.3	12.4	21.1	29.0	35.7
90	1.4	1.4	7.0	15.3	24.9	32.8	40.0
100	1.4	1.4	9.3	19.1	28.9	37.0	44.7
110	1.4	1.8	12.1	23.4	33.0	41.5	49.7
120	1.4	5.5	16.1	27.9	37.5	46.4	54.9
130	1.4	8.9	21.1	32.5	42.4	51.7	60.6

Future years

The influence of continual fleet renewal and more stringent emission standards for new vehicles is taken into consideration by the factor "ft".

TABLE 11 - INFLUENCING FACTOR (FT) FOR PASSENGER CARS, TECHNOLOGY STANDARD A					
ft	CO		NO_x		Opacity
Passenger cars	Gasoline	Diesel	Gasoline	Diesel	Diesel
2010	1.00	1.00	1.00	1.00	1.00
2015	0.75	0.74	0.65	0.76	0.55
2020	0.58	0.65	0.44	0.52	0.29
2025	0.46	0.60	0.30	0.40	0.17
2030	0.40	0.57	0.22	0.35	0.13

Altitude factor -fh: For altitudes of up to 1,000m above sea level, the altitude factor "fh" is 1.0. *Table 12* shows the altitude factors valid for an altitude of 2,000 m. The altitude factors for altitudes between 1,000m and 2,000 m can be derived through linear interpolation. For altitudes higher than 2,000m, the data is sparse, but it can be assumed that the values in Table 12 apply even for higher altitudes.

TABLE 12 - ALTITUDE FACTOR (FH) FOR PASSENGER CARS, TECHNOLOGY STANDARD A					
fh	CO		NO_x		Opacity
Passenger cars	Gasoline	Diesel	Gasoline	Diesel	Diesel
2010	2.6	1.0	1.0	1.0	1.0
2015	2.0	1.0	1.0	1.0	1.0
2020	1.6	1.0	1.0	1.0	1.0
2025	1.0	1.0	1.0	1.0	1.0
2030	1.0	1.0	1.0	1.0	1.0

Light-Duty Vehicles (LDV)

The base emission factor quantifies the vehicle specific tailpipe emission for specific pollutants as a function of average vehicle speed and road gradient. The factor given is a mix for diesel and gasoline Light-Duty vehicles according to the proportion provided in *table 13.*

TABLE 13 - PERCENTAGE OF DIESEL AND GASOLINE LDV, TECHNOLOGY STANDARD A	
Percentage LDV (average 2010 – 2030)	
Diesel	Gasoline
96%	4%

TABLE 14 - BASE EMISSION FACTORS FOR CO (EC EURO REGULATION), LIGHT-DUTY VEHICLES (DIESEL/GASOLINE MIX)							
LDV CO [g/h] 2010							
v [km/h]	Gradient [%]						
	- 6	- 4	- 2	0	2	4	6
0	2.3	2.3	2.3	2.3	2.3	2.3	2.3
10	8.1	8.1	8.7	13.4	16.5	19.3	16.0
20	8.1	8.1	10.8	17.4	16.1	10.7	11.2
30	8.1	8.1	13.0	18.3	10.3	12.7	18.7
40	8.1	8.1	14.8	13.1	11.6	17.8	29.6
50	8.1	8.1	15.6	10.8	15.2	26.6	43.1
60	8.1	8.1	18.2	10.6	21.6	39.3	57.1
70	8.1	8.1	16.3	15.0	31.7	53.3	74.0
80	8.1	8.1	10.5	21.8	45.9	68.3	94.3
90	8.1	13.7	12.2	32.1	58.8	86.3	118.0
100	8.1	17.0	19.4	47.8	76.2	109.7	147.8
110	8.1	17.1	31.8	63.6	98.1	138.2	183.5
120	14.9	17.2	49.5	83.9	125.2	172.7	196.4
130	11.2	31.2	68.1	109.5	158.4	180.5	212.4

TABLE 15 - BASE EMISSION FACTORS FOR (EC EURO REGULATION), LIGHT-DUTY VEHICLES (DIESEL/GASOLINE MIX)							
LDV NO_x [g/h] 2010							
v [km/h]	Gradient [%]						
	- 6	- 4	- 2	0	2	4	6
0	9.1	9.1	9.1	9.1	9.1	9.1	9.1
10	9.8	9.8	10.4	15.2	18.3	20.9	21.8
20	9.8	9.8	12.6	19.1	21.8	22.5	28.1
30	9.8	9.8	14.8	21.7	22.6	31.8	44.6
40	9.8	9.8	16.6	22.1	28.9	36.7	62.6
50	9.8	9.8	17.4	22.5	37.6	58.2	80.0
60	9.8	9.8	19.8	26.3	50.0	75.5	108.9
70	9.8	9.8	21.8	37.0	65.5	100.5	145.4
80	9.8	9.8	22.6	50.3	84.5	133.1	188.7
90	9.8	15.6	30.5	66.1	112.4	171.8	239.1
100	9.8	21.8	46.0	88.6	150.0	221.4	301.8
110	9.8	24.5	65.7	122.8	196.7	281.6	376.3
120	16.7	41.8	92.4	166.5	254.2	353.8	402.9
130	22.4	64.8	132.5	221.1	323.9	370.1	435.8

TABLE 16 - BASE EMISSION FACTORS FOR PM (OPACITY) (EC EURO REGULATION), LIGHT-DUTY VEHICLES (DIESEL/GASOLINE MIX)							
LDV Opacity [m²/h] 2010							
v [km/h]	Gradient [%]						
	- 6	- 4	- 2	0	2	4	6
0	6.4	6.4	6.4	6.4	6.4	6.4	6.4
10	1.1	1.1	1.3	2.8	4.1	5.3	6.6
20	1.1	1.1	1.9	4.5	6.6	8.7	10.9
30	1.1	1.1	2.7	6.1	8.9	12.0	15.7
40	1.1	1.1	3.4	7.5	11.2	13.8	20.4
50	1.1	1.1	3.7	8.6	13.7	19.3	24.3
60	1.1	1.1	4.8	10.5	17.1	23.4	28.9
70	1.1	1.1	6.5	13.5	21.1	27.7	33.9
80	1.1	1.1	8.8	17.2	25.2	32.3	39.1
90	1.1	3.0	11.7	21.3	29.4	37.2	44.6
100	1.1	6.4	16.0	25.8	34.5	42.7	50.6
110	1.1	10.0	21.2	30.9	40.0	48.7	57.2
120	3.4	14.9	26.4	36.5	46.1	55.3	60.3
130	8.4	21.0	32.2	42.7	52.6	56.7	64.6

Time factor - ft: The influence of continual fleet renewal and more stringent emission standards for new vehicles is taken into consideration by the factor "ft".

TABLE 17 - INFLUENCING FACTOR (FT) FOR YEARS DIFFERENT TO THE BASE YEAR, LDV, TECHNOLOGY STANDARD A			
ft	CO	NO_x	Opacity
Light-Duty vehicles	diesel/gasoline mix	diesel/gasoline mix	diesel/gasoline mix
2010	1.00	1.00	1.00
2015	0.72	0.76	0.54
2020	0.47	0.49	0.30
2025	0.39	0.36	0.20
2030	0.35	0.30	0.15

Altitude factor - fh: For this vehicle class, there is no identifiable influence for altitudes up to 2,000 m above sea level.

Heavy goods vehicles and buses (HGV)

The base emission factor quantifies the vehicle-specific tailpipe emission for a specific pollutant as a function of average vehicle speed and road gradient. The factors only exist for diesel HGV. The base emission factors for diesel HGV given in the following tables refer to an average vehicle mass of 23 t (mix of lorries, lorry-trailer combinations, semi-trailers). Buses can be calculated using the HGV tables, using a

lower mass factor. A mass of 15t is proposed for buses and coaches. In this case, the values must be adjusted to compensate for the reduced mass.

TABLE 18 - BASE EMISSION FACTORS FOR CO (EC EURO REGULATION), DIESEL HEAVY GOODS VEHICLES (AVERAGE MASS OF 23 t)

HGV Diesel CO [g/h] 2010							
v [km/h]	Gradient [%]						
	- 6	- 4	- 2	0	2	4	6
0	12.5	12.5	12.5	12.5	12.5	12.5	12.5
10	17.5	20.3	32.8	42.5	44.5	44.3	46.8
20	13.5	17.9	30.6	44.8	44.3	51.8	59.0
30	12.4	18.1	38.8	44.9	49.0	60.9	68.9
40	11.2	16.7	40.3	44.6	55.5	68.1	77.7
50	11.2	15.6	38.6	44.8	61.9	74.4	87.6
60	11.2	13.9	35.4	46.3	67.2	81.3	98.6
70	11.2	11.8	31.6	49.9	71.9	88.9	110.3
80	11.2	12.2	35.9	55.7	77.1	98.3	124.4
90	11.2	13.0	38.1	61.7	83.1	108.3	138.6
100	11.2	14.7	43.1	67.4	89.8	118.8	152.8
110	11.2	17.4	46.2	72.8	96.7	129.3	166.9
120	11.2	23.7	50.8	77.0	103.7	139.6	180.9
130	12.3	28.2	57.7	80.5	110.7	149.8	195.1

TABLE 19 - BASE EMISSION FACTORS FOR NO_x (EC EURO REGULATION), DIESEL HEAVY GOODS VEHICLES (AVERAGE MASS OF 23 t)

HGV Diesel NO_x [g/h] 2010							
v [km/h]	Gradient [%]						
	- 6	- 4	- 2	0	2	4	6
0	72.5	72.5	72.5	72.5	72.5	72.5	72.5
10	38.1	55.5	115.9	163.5	192.8	219.5	251.0
20	25.1	40.0	130.0	182.4	223.8	294.9	367.0
30	22.4	41.3	147.6	202.1	271.2	387.4	494.5
40	19.2	36.8	148.0	218.0	329.2	482.9	617.9
50	19.2	32.2	148.1	229.7	397.0	574.7	747.4
60	19.2	25.8	150.0	247.4	467.8	670.1	881.3
70	16.8	20.5	151.0	278.8	535.9	773.9	1,017.9
80	19.2	21.4	152.0	327.9	614.7	883.0	1,159.0
90	19.2	23.7	153.8	390.1	697.7	990.1	1,298.8
100	19.2	29.3	190.9	465.8	779.5	1,094.3	1,437.6
110	19.2	43.8	231.6	547.9	856.7	1,197.2	1,575.5
120	19.4	74.6	280.5	613.8	926.6	1,299.2	1,712.6
130	23.5	105.1	348.4	660.2	997.1	1,400.3	1,849.7

TABLE 20 - BASE EMISSION FACTORS FOR PM (OPACITY) (EC EURO REGULATION), DIESEL HEAVY GOODS VEHICLES (AVERAGE MASS OF 23 t)							
HGV Diesel Opacity [m²/h] 2010							
v [km/h]	Gradient [%]						
	- 6	- 4	- 2	0	2	4	6
0	11.0	11.0	11.0	11.0	11.0	11.0	11.0
10	13.6	13.4	15.5	18.2	21.4	25.1	28.2
20	11.9	13.8	15.0	19.9	25.7	31.5	36.5
30	11.4	13.8	17.3	22.5	29.7	38.0	45.3
40	10.8	13.3	17.8	24.9	33.9	44.6	53.6
50	10.8	13.0	17.6	26.3	38.7	50.6	62.5
60	10.8	12.4	17.5	28.0	43.6	57.1	71.9
70	10.8	11.2	16.5	30.4	48.2	64.0	81.7
80	10.8	11.4	17.4	33.9	53.3	71.8	92.5
90	10.8	11.9	19.6	38.5	58.9	79.8	103.3
100	10.8	12.9	21.9	43.7	64.6	87.8	114.2
110	10.8	13.2	25.5	49.0	70.1	95.8	124.9
120	10.9	15.1	29.6	53.1	75.5	103.7	135.5
130	11.4	18.0	34.6	56.3	80.9	111.5	146.3

TABLE 21 - MASS FACTORS (FM)			
Type	CO	NO_x	Opacity
15t (Single lorry)*	0.7	0.7	0.7
23 t (average)**	1.0	1.0	1.0
32 t (Lorry-trailer combination/semitrailer)	1.9	1.9	1.9
* including coaches ** average consists of 58% single lorries and 42% truck/trailer or semi trailer combinations			

Future years - ft: The influence of continual fleet renewal and more stringent emission standards for new vehicles is taken into consideration by the factor “ft”.

TABLE 22 - INFLUENCING FACTOR (FT) FOR YEARS OTHER THAN THE BASE YEAR, HEAVY GOODS VEHICLES, TECHNOLOGY STANDARD A			
Year	CO	NO_x	Opacity
2010	1.00	1.00	1.00
2015	0.58	0.61	0.59
2020	0.34	0.35	0.33
2025	0.25	0.23	0.21
2030	0.21	0.18	0.16

Altitude factor - fh: For heavy-goods vehicles and altitudes below 2,000 m above sea level no identifiable altitude factor (fh) exists.

3.6. EMISSION FACTORS FOR OTHER REGIONS

3.6.1. General

Due to the active participation of various countries within this task, it was possible to generate emission factors for selected countries outside the *"technology standard A"* countries (western European countries, North America). Specific emission factors for countries which participated actively by providing the vehicle fleet data are listed in the appendix.

3.6.2. Correlation factors for other technology standards (fe)

Based on the calculations mentioned above the following correlation factors are proposed:

TABLE 23 - CORRELATION FACTOR FOR COUNTRIES REFERRING TO TECHNOLOGY STANDARD GROUP B

Vehicle type	CO	NO_x	PM
PC gasoline/diesel	1.5 / 2.0	1.8 / 1.1	- / 1.4
LDV mix	2.7	1.4	2.2
HGV diesel	1.9	1.6	2.5

TABLE 24 - CORRELATION FACTOR FOR COUNTRIES REFERRING TO TECHNOLOGY STANDARD GROUP C

Vehicle type	CO	NO_x	PM
PC gasoline/diesel	2.9 / 4.0	2.8 / 1.2	- / 2.0
LDV mix	3.5	1.5	2.6
HGV diesel	2.3	1.8	2.8

Table 25, following page, provides an indication which of the standards (A, B or C) is to be applied. The percentage of pre EU 1 vehicles for each vehicle type is the criterion for the selection of the emission standards category. Note that for PCs and LDVs there may be a difference between diesel and gasoline cars.

TABLE 25 - CRITERIA FOR STANDARD A, B AND C CATEGORY SELECTION			
Reference year: 2010	**Percentage of pre-EU1 vehicles**		
Type	**Standard A**	**Standard B**	**Standard C**
PC gasoline	< 20%	20% - 30%	> 30%
PC diesel	< 5%	5% - 30%	> 30%
LDV gasoline	< 40%	40% - 60%	> 60%
LDV diesel	< 5%	5% - 25%	> 25%
HVG diesel	< 5%	5% - 40%	> 40%

Moreover, the correlation factor fe does not take into account any change of the altitude factor as a function of the technology standard. For countries with technology standard B, the altitude factors fh given in *table 26* have to be taken into account.

Note that in cases of countries without regular emission checks a downgrading might be required *(see chapter 3.2, page 18)*.

TABLE 26 - ALTITUDE FACTOR FH FOR TECHNOLOGY STANDARD GROUP B					
fh	**CO**		**NO_x**		**Opacity**
Passenger cars	Gasoline	Diesel	Gasoline	Diesel	Diesel
0 m	1.0	1.0	1.0	1.0	1.0
1,000 m	2.2	1.2	1.0	1.0	1.0
2,000 m	3.0	1.5	1.0	1.0	1.25
3,000 m	4.0	1.5	1.0	1.0	1.5

For technology standard C the factor for CO emissions has to be increased by 30%. The factors for NO_X and opacity remain as given in *table 26*.

3.7. NON EXHAUST PARTICULATE EMISSION FACTORS

Factors for non exhaust particulate emissions are only dependent on the type of vehicle and not on the model year. Current knowledge remains that the emissions are proportional to the number of vehicles in the tunnel. This is true for the abrasion and wear component but not for the re-suspension of particles. However, due to the lack of research in this area, the linearity between emissions and number of vehicles has to be maintained as the best approach [12]. Based on the available information, the $PM_{2.5}$ emission factors are set as constant on a per-vehicle basis, and are independent of vehicle speed. The apparent dependency on vehicle speed is only the result of converting the unit [mg/km] *(from table 27, following page)* to [g/h] *(table 28, following page)*.

TABLE 27 - FACTORS FOR $PM_{2.5}$ NON-EXHAUST EMISSIONS [13]				
	PC/LDV	PC/LDV	HGV	HGV
	[mg/km]	[m²/km]	[mg/km]	[m²/km]
Non-exhaust $PM_{2.5}$	28	0.1316	104	0.4888

TABLE 28 - $PM_{2.5}$ AND OPACITY FACTORS FOR NON-EXHAUST EMISSIONS				
	PC		HGV	
v [km/h]	[g/h]	[m²/h]	[g/h]	[m²/h]
0	0	0	0	0
10	0.28	1.3	1.04	4.9
20	0.56	2.6	2.08	9.8
30	0.84	3.9	3.12	14.7
40	1.12	5.3	4.16	19.6
50	1.4	6.6	5.2	24.4
60	1.68	7.9	6.24	29.3
70	1.96	9.2	7.28	34.2
80	2.24	10.5	8.32	39.1
90	2.52	11.8	9.36	44.0
100	2.8	13.2	10.4	48.9
110	3.08	14.5		
120	3.36	15.8		
130	3.64	17.1		

4. CONCLUSIONS

The current document allows the calculation of the fresh air demand for designing a tunnel ventilation system. The emission factors given in this document are based on the emissions of vehicles within the European Union. Correlation factors for regions with other emission standards are given within this document. With the updated and extended data base, it is possible to calculate the fresh air amount which has to be provided by the ventilation system to ensure a safe passage through the tunnel. Emission projections are possible for years up to 2020. Dependent on the availability of vehicle fleet data, two methodologies for calculation vehicle emissions are described. One offers a simple approach based on the emission estimations for the year 2010 and the application of different correction factors for year of operation, altitude of the tunnel, and vehicle mass (for HGVs only). In cases where the vehicle fleet data is known in detail, a more accurate calculation can be performed using the detailed tables for emission factors for single vehicle model years (i.e. emission standards).

However, it is always in the responsibility of the designer of the ventilation system to check the appropriateness of the emissions factors for their project.

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GLOSSARY

Term	Definition
NO_x	Oxides of Nitrogen
CO	Carbon monoxide
PM_{10}	suspended particles in the air, with an aerodynamic diameter smaller than 10 µm
$PM_{2.5}$	suspended particles in the air, with an aerodynamic diameter smaller than 2.5 µm
PC	Passenger cars
LDV	Light-Duty vehicles, gross weight < 3.5 t
HGV	Heavy Goods vehicle, gross weight > 3.5 t
pcu	Passenger car units
EC	European Commission
CNG	Compressed natural gas

APPENDICES

1. LIST OF SYMBOLS

n_{veh}	number of vehicles in tunnel [-]
D	traffic density [veh/km] or [pcu/km]
D_0	traffic density for v = 0 km/h [veh/km] or [pcu/km]
L	length of tunnel [km]
v	vehicle speed [km/h]
M	traffic volume [pcu/h]
Q	emission for CO, NO_X [g/(h.veh)] and emissions of particle matter [m²/(h.veh)]
C_{adm}	admissible concentration of pollutant [g/m³]
C_{amb}	ambient (background) concentration of pollutant [g/m³]
K_{adm}	admissible extinction coefficient [m^{-1}]
K	light extinction [km^{-1}]
$\dot{V}$	Air volume Flow [m³/h]
fh	altitude factor [-]
ft	influence factor for years differing from the base year [-]
fe	influence factor for technology standards [-]
fm	influence factors for vehicle gross masses [-]
µ	$PM_{2.5}$ mass concentration [mg/m³]

2. GENERAL REMARKS ON THE GENERATION OF EMISSION FACTORS

The emission factors have been derived from extensive measurements of in-use vehicles. It is in the nature of the task that for new technology vehicles less data exist and for vehicles fulfilling the upcoming emission standards only projections are available. When working with the emission tables the following facts have to be considered:

- Constant values for emissions at high negative road gradient over almost all speed ranges are a fact. In fact they are not constant but they show a big spreading dependent on status of engine temperature, regeneration status/temperature of exhaust gas after-treatment systems, etc.
- Consequently the same vehicle can differ by an order of magnitude for multiple measurements at the same load point. As the absolute level of the emission quantity is low for these load points, the emission value is taken as a constant in terms of fresh air demand calculations in order to be on the safe side.
- There are not many tests made until now with EURO 6 HGV vehicles neither in certification conditions nor in real operation conditions. As the NO_x emission level needs to be quite low for EURO 6 different manufacturers follow totally different NO_x reduction strategies. It depends strongly on the EGR rate and the SCR operation strategy of the manufacturer. Especially off-cycle, they follow a strongly fuel optimised strategy, which is not the best for NO_x emissions. At low gradients it could happen that the SCR temperature falls under the operation limit of this strategy or at least in a region with little efficiency.

3. EMISSION FACTORS FOR SPECIFIC COUNTRIES

During the PIARC working cycle 2008-2011, questionnaires concerning fleet distribution data and emission standards (implementation years) were sent to the national delegates of PIARC and other institutions to collect country-specific vehicle-emission information. Based on the information received, emission factors for certain countries were derived.

3.1. EMISSION FACTORS FOR AUSTRALIA

According to the simplified method, the following emission factors can be used. Base year is the year 2010. Deviations from that year have to be calculated using the appropriate factors for future emissions (ft).

3.1.1. Passenger cars

Base emission factors

The base emission factor quantifies the vehicle specific tailpipe emission for a specific pollutant as a function of average vehicle speed and road gradient. The factor differs for gasoline and diesel fuelled cars.

TABLE 29 - BASE EMISSION FACTORS FOR CO, PASSENGER CARS

PC gasoline CO [g/h] 2010							
v [km/h]	Gradient [%]						
	- 6	- 4	- 2	0	2	4	6
0	38.9	38.9	38.9	38.9	38.9	38.9	38.9
10	45.3	48.5	52.4	56.3	61.9	68.1	80.3
20	51.6	58.2	66.0	73.7	84.8	97.3	121.7
30	51.7	61.4	73.4	88.3	106.1	126.2	166.7
40	51.4	64.4	81.8	106.1	136.1	177.3	227.3
50	50.3	66.1	88.9	120.8	164.6	228.0	307.0
60	48.8	66.5	93.9	132.8	191.4	274.1	408.6
70	47.4	66.1	96.9	145.2	221.8	326.7	532.1
80	46.7	65.9	99.7	161.0	262.1	408.1	677.6
90	47.5	67.4	105.0	181.6	318.4	543.9	849.0
100	50.1	72.2	115.9	207.5	396.0	753.9	1,049.5
110	54.7	81.5	135.2	240.0	501.1	1,040.0	1,307.0
120	60.7	96.1	163.8	284.7	643.9	1,302.3	1,679.9
130	67.1	115.6	199.3	356.2	843.7	1,589.2	2,163.5

TABLE 30 - BASE EMISSION FACTORS FOR NO_X, PASSENGER CARS							
PC Essence NO_x [g/h] 2010							
v [km/h]	Gradient [%]						
	- 6	- 4	- 2	0	2	4	6
0	2.9	2.9	2.9	2.9	2.9	2.9	2.9
10	6.3	6.3	6.3	8.5	10.1	11.3	12.5
20	6.3	6.3	6.5	10.4	12.4	17.6	24.5
30	6.3	6.3	7.7	11.8	18.0	26.2	30.4
40	6.3	6.3	8.4	13.4	23.9	30.2	34.8
50	6.3	6.3	8.5	16.0	27.6	33.5	38.4
60	6.3	6.3	9.6	20.3	31.0	37.2	47.1
70	6.3	6.3	11.1	26.4	34.5	42.9	59.3
80	6.3	6.3	13.3	30.0	38.1	53.7	73.0
90	6.3	6.3	19.6	33.6	44.9	65.9	88.3
100	6.3	8.4	27.1	37.6	56.5	80.6	106.2
110	6.3	12.2	31.8	45.1	70.4	97.6	126.5
120	6.3	21.6	36.6	58.1	86.7	117.2	149.5
130	7.2	29.6	44.4	73.8	105.7	139.7	175.4

TABLE 31 - BASE EMISSION FACTORS FOR CO PASSENGER CARS							
PC Diesel CO [g/h] 2010							
v [km/h]	Gradient [%]						
	- 6	- 4	- 2	0	2	4	6
0	3.3	3.3	3.3	3.3	3.3	3.3	3.3
10	9.6	9.6	9.6	10.3	10.9	11.4	12.0
20	9.6	9.6	9.8	11.0	11.9	11.2	12.9
30	9.6	9.6	10.1	11.6	11.2	13.3	12.9
40	9.6	9.6	10.1	12.0	12.4	13.3	9.8
50	9.6	9.6	10.0	11.5	13.7	10.8	8.1
60	9.6	9.6	10.2	11.2	13.2	8.8	7.5
70	9.6	9.6	10.7	12.4	10.7	7.3	8.5
80	9.6	9.6	11.4	12.2	8.8	7.9	9.5
90	9.6	9.6	11.5	12.3	7.4	8.8	10.5
100	9.6	9.6	11.5	9.8	7.8	9.8	11.6
110	9.6	9.9	11.7	7.9	8.8	10.9	12.8
120	9.6	10.5	11.7	7.6	9.9	12.1	14.1
130	9.6	11.0	11.0	10.0	11.1	13.3	15.4

TABLE 32 - BASE EMISSION FACTORS FOR NO_X, PASSENGER CARS							
PC Diesel NO_x [g/h] 2010							
v [km/h]	Gradient [%]						
	- 6	- 4	- 2	0	2	4	6
0	8.8	8.8	8.8	8.8	8.8	8.8	8.8
10	8.0	8.0	8.0	13.8	18.4	22.3	26.3
20	8.0	8.0	9.1	19.1	25.8	31.5	41.1
30	8.0	8.0	11.5	23.6	31.9	43.5	57.8
40	8.0	8.0	12.2	26.7	38.9	55.9	75.5
50	8.0	8.0	11.2	28.6	45.7	68.5	92.0
60	8.0	8.0	13.0	31.9	56.3	84.2	113.6
70	8.0	8.0	16.8	39.0	69.5	101.6	140.5
80	8.0	8.0	22.1	48.4	84.2	124.0	170.0
90	8.0	8.0	27.5	60.3	100.5	149.5	202.1
100	8.0	8.0	35.1	75.8	123.3	179.6	239.0
110	8.0	9.9	46.8	93.9	150.9	214.0	280.3
120	8.0	22.8	63.4	117.3	183.2	253.2	326.4
130	8.0	33.7	84.2	147.8	220.7	297.7	378.0

TABLE 33 - BASE EMISSION FACTORS FOR EXHAUST PARTICLES (OPACITY), PASSENGER CARS							
PC Diesel Opacity [m^2/h] 2010							
v [km/h]	Gradient [%]						
	- 6	- 4	- 2	0	2	4	6
0	2.8	2.8	2.8	2.8	2.8	2.8	2.8
10	2.3	2.3	2.3	5.1	7.7	10.2	13.0
20	2.3	2.3	2.8	8.2	12.6	16.8	21.7
30	2.3	2.3	3.9	11.1	17.0	22.9	29.5
40	2.3	2.3	4.3	13.3	20.6	28.7	37.0
50	2.3	2.3	4.5	14.7	24.0	34.0	43.6
60	2.3	2.3	4.7	17.0	28.8	40.5	51.7
70	2.3	2.3	6.8	20.7	34.4	47.4	60.6
80	2.3	2.3	10.1	25.3	40.5	55.2	69.9
90	2.3	2.3	13.9	30.6	47.0	63.5	79.6
100	2.3	2.3	18.7	37.1	55.0	72.9	90.2
110	2.3	3.1	24.5	44.4	64.0	83.1	101.6
120	2.3	10.5	31.9	53.0	73.9	94.2	113.9
130	2.3	18.0	40.5	63.0	85.0	106.3	127.1

Future years (ft)

The influence of continual fleet renewal and more stringent emission standards for new vehicles is taken into consideration by the factor ft.

TABLE 34 - INFLUENCING FACTOR (ft) FOR YEARS DIFFERENT TO THE BASE-YEAR					
ft	**CO**		**NO_x**		**Opacity**
Passenger cars	Gasoline	Diesel	Gasoline	Diesel	Diesel
2010	1.00	1.00	1.00	1.00	1.00
2015	0.59	0.67	0.55	0.84	0.64
2020	0.42	0.43	0.31	0.61	0.37
2025/30	n.a	n.a	n.a	n.a	n.a

Altitude factor (fh)

Unfortunately there is no data available regarding an altitude factor.

3.1.2. Light-Duty Vehicles

The base emission factor quantifies the vehicle specific tailpipe emission for a specific pollutant as a function of average vehicle speed and road gradient.

If the vehicle split is given in HGV and PC, the PC proportion can be further divided into passenger cars (PC) and light-duty vehicles (LDV) according to the values given in *table 35*. *Table 36* indicates the percentage of gasoline and diesel fuelled LDV.

TABLE 35 - PERCENTAGE OF LIGHT-DUTY VEHICLES AND PASSENGER CARS (FLEET MIX)	
Percentage LDV / PC	
LDV	PC
16%	84%

TABLE 36 - PERCENTAGE OF DIESEL AND GASOLINE LDV	
Percentage LDV (average 2010 – 2030)	
Diesel	Gasoline
50%	50%

The proportion of diesel and gasoline fuelled vehicles given in *table 36* was used to calculate the base emission factors and influencing factors given below.

TABLE 37 - BASE EMISSION FACTORS FOR CO, LIGHT-DUTY VEHICLES (DIESEL/GASOLINE MIX)							
LDV CO [g/h] 2010							
v [km/h]	Gradient [%]						
	- 6	- 4	- 2	0	2	4	6
0	10.7	10.7	10.7	10.7	10.7	10.7	10.7
10	34.8	34.8	38.5	73.8	100.3	124.5	126.0
20	34.8	34.8	53.3	108.4	96.9	53.9	63.1
30	34.8	34.8	70.6	116.0	51.1	78.4	145.2
40	34.8	34.8	85.9	72.8	66.2	148.6	274.5
50	34.8	34.8	92.5	54.8	105.8	239.0	439.6
60	34.8	34.8	115.0	56.5	179.4	393.2	616.9
70	34.8	34.8	120.0	102.9	299.8	567.8	831.4
80	34.8	34.8	130.0	181.4	474.8	758.9	1,089.6
90	34.8	76.8	140.0	304.8	637.6	988.4	1,393.1
100	34.8	105.1	153.4	498.6	858.7	1,286.6	1,775.3
110	34.8	119.9	300.8	698.6	1,138.0	1,651.9	2,233.2
120	86.3	128.3	520.5	957.2	1,485.2	2,094.2	2,394.0
130	58.1	293.6	755.5	1,284.5	1,910.5	2,194.8	2,592.0

TABLE 38 - BASE EMISSION FACTORS FOR NO_X, LIGHT-DUTY VEHICLES (DIESEL/GASOLINE MIX)							
LDV NO_x [g/h] 2010							
v [km/h]	Gradient [%]						
	- 6	- 4	- 2	0	2	4	6
0	8.9	8.9	8.9	8.9	8.9	8.9	8.9
10	9.3	9.3	10.2	20.2	29.2	38.6	35.3
20	9.3	9.3	14.1	32.2	35.3	37.0	32.5
30	9.3	9.3	19.1	38.9	26.8	37.5	55.7
40	9.3	9.3	24.1	30.8	33.6	55.9	82.8
50	9.3	9.3	26.4	27.5	45.6	76.0	110.7
60	9.3	9.3	34.8	30.2	63.6	103.3	143.7
70	9.3	9.3	35.8	44.8	64.1	134.5	182.4
80	9.3	9.3	35.7	64.0	87.1	169.5	227.0
90	9.3	18.7	35.8	88.3	147.5	209.7	277.3
100	9.3	24.3	57.6	121.3	187.2	259.9	338.5
110	9.3	29.8	87.6	158.7	235.1	319.0	409.4
120	24.2	51.5	125.5	204.4	292.3	388.1	436.3
130	28.1	86.3	168.9	259.5	359.7	403.8	470.8

TABLE 39 - BASE EMISSION FACTORS FOR PM (OPACITY), LIGHT-DUTY VEHICLES (DIESEL/GASOLINE MIX)							
LDV Opacity [m²/h] 2010							
v [km/h]	Gradient [%]						
	- 6	- 4	- 2	0	2	4	6
0	5.8	5.8	5.8	5.8	5.8	5.8	5.8
10	1.2	1.2	1.4	3.4	5.1	6.7	8.4
20	1.2	1.2	2.2	5.6	8.4	11.2	14.2
30	1.2	1.2	3.2	7.7	11.5	15.5	19.7
40	1.2	1.2	4.1	9.6	14.5	19.7	25.0
50	1.2	1.2	4.6	11.1	17.4	23.8	30.1
60	1.2	1.2	6.0	13.6	21.3	28.8	36.5
70	1.2	1.2	8.3	17.2	25.8	34.7	43.4
80	1.2	1.2	11.4	21.4	31.3	41.2	50.8
90	1.2	3.6	15.0	26.0	37.2	48.0	58.6
100	1.2	8.1	20.1	32.2	44.2	56.0	67.5
110	1.2	12.9	25.9	39.2	52.1	64.7	77.1
120	4.2	18.8	33.0	47.1	60.9	74.3	81.4
130	10.8	25.6	41.1	55.9	70.4	76.4	87.4

Future years (ft)

The influence of continual fleet renewal and more stringent emission standards for new vehicles is taken into consideration by the factor ft.

TABLE 40 - INFLUENCING FACTOR (FT) FOR YEARS DIFFERENT TO THE BASE-YEAR, LDV (DIESEL/GASOLINE MIX)			
ft	CO	NO_x	Opacity
LDV	diesel/gasoline mix	diesel/gasoline mix	diesel/gasoline mix
2010	1.00	1.00	1.00
2015	0.69	0.72	0.64
2020	0.51	0.48	0.41
2025/30	n.a.	n.a.	n.a.

Altitude factor (fh)

Unfortunately there is no data available concerning an altitude factor.

3.1.3. Trucks

The base emission factor quantifies the vehicle-specific tailpipe emission for a certain pollutant as a function of average vehicle speed and road gradient. The factors exist for Diesel HGV only.

TABLE 41 - BASE EMISSION FACTORS FOR CO (ECE/EURO- REGULATION), HEAVY-GOODS VEHICLES DIESEL (AVERAGE MASS OF 23 t)							
HGV Diesel CO [g/h] 2010							
v [km/h]	Gradient [%]						
	- 6	- 4	- 2	0	2	4	6
0	38.6	38.6	38.6	38.6	38.6	38.6	38.6
10	30.4	35.0	52.3	63.6	69.5	75.2	81.7
20	21.9	31.4	55.0	67.6	76.0	90.2	105.1
30	20.0	32.3	60.2	71.6	85.8	109.7	131.2
40	18.2	29.6	62.1	75.4	97.9	129.4	156.3
50	18.2	27.2	60.6	78.3	112.3	147.8	183.9
60	18.2	23.5	56.2	82.1	127.0	167.4	212.4
70	18.2	19.4	51.6	88.3	140.5	188.6	242.1
80	18.2	20.3	56.9	98.9	156.3	212.2	274.5
90	18.2	22.3	62.7	113.3	173.1	236.0	306.8
100	18.2	26.5	71.8	129.5	190.1	260.0	339.0
110	18.2	30.3	80.6	143.5	206.2	283.7	371.0
120	18.5	44.4	91.5	154.0	222.5	307.1	402.7
130	21.1	50.9	105.3	163.3	238.5	330.4	434.8

TABLE 42 - BASE EMISSION FACTORS FOR NO_X, HEAVY-GOODS VEHICLES DIESEL (AVERAGE MASS OF 23 t)							
HGV Diesel NO_x [g/h] 2010							
v [km/h]	Gradient [%]						
	- 6	- 4	- 2	0	2	4	6
0	84.3	84.3	84.3	84.3	84.3	84.3	84.3
10	50.3	65.3	132.7	190.2	237.8	296.0	356.9
20	31.8	52.8	151.1	217.2	305.3	432.3	551.7
30	28.2	55.0	174.0	256.1	394.2	588.6	769.8
40	25.2	48.8	183.3	295.1	493.2	751.3	984.6
50	25.2	42.6	176.8	323.0	607.1	911.6	1,212.2
60	25.2	33.3	154.6	357.7	727.7	1,079.6	1,443.1
70	25.2	26.7	155.6	414.5	847.1	1,260.5	1,676.6
80	25.2	28.0	163.5	499.4	987.2	1,445.3	1,912.2
90	25.2	31.5	199.3	607.3	1,129.1	1,623.3	2,145.6
100	25.2	41.6	261.0	741.0	1,266.1	1,796.9	2,377.2
110	25.2	60.4	336.0	870.6	1,388.8	1,968.3	2,607.1
120	25.8	106.2	429.3	967.2	1,507.1	2,138.2	2,835.9
130	33.1	161.2	534.1	1,042.4	1,623.7	2,306.4	3,064.4

TABLE 43 - BASE EMISSION FACTORS FOR PM (OPACITY), HEAVY-GOODS VEHICLES DIESEL (AVERAGE MASS OF 23 t)							
HGV Diesel Opacity [m²/h] 2010							
v [km/h]	Gradient [%]						
	- 6	- 4	- 2	0	2	4	6
0	38.8	38.8	38.8	38.8	38.8	38.8	38.8
10	25.3	27.7	38.0	45.8	52.8	60.0	66.4
20	18.0	25.9	36.4	49.5	61.1	73.5	86.7
30	16.3	26.4	44.4	54.8	69.8	90.9	111.9
40	14.7	24.4	45.7	59.9	80.1	109.9	136.4
50	14.7	22.9	45.0	63.1	93.2	128.1	163.2
60	14.7	20.6	42.9	66.6	107.4	147.4	190.6
70	14.7	17.9	43.1	71.9	120.9	168.3	218.7
80	14.7	16.7	42.9	80.7	136.6	190.6	248.5
90	14.7	18.9	48.9	93.7	153.2	212.8	278.1
100	14.7	23.2	55.5	109.4	169.6	234.7	307.5
110	14.7	24.6	64.2	123.8	184.6	256.5	336.8
120	14.9	35.5	74.3	134.4	199.5	277.9	365.8
130	17.2	42.3	86.0	143.4	214.3	299.3	395.1

HGV Type-dependent factor (fm)

The emission factors given are calculated for the fleet mix of heavy-goods vehicles. This fleet mix consists of single lorries, trailer trucks and coaches, whereas coaches can be related to single lorries.

TABLE 44 - PERCENTAGE VARIATION OF HEAVY-GOODS VEHICLES AUSTRALIA (AVERAGE MIX)	
Type	Percentage
15 t (Single lorry)	83%
32 t (Truck – trailer combination/semitrailers)	17%

TABLE 45 - HGV TYPE DEPENDENT FACTOR (FM) TO THE AVERAGE EMISSION FACTORS FOR DIFFERENT TYPES OF HGV			
Type	CO	NO_x	Opacity
15 t (Single lorry*)	0,7	0,7	0,7
32 t (Truck – trailer combination/semitrailers)	1,9	1,9	1,9
* including coaches			

Future years (ft)

The influence of continual fleet renewal and more stringent emission standards for new vehicles is taken into consideration by the factor ft.

TABLE 46 - INFLUENCING FACTOR (FT) FOR YEARS DIFFERENT TO THE BASE YEAR, HGV			
Year	CO	NO_x	Opacity
2010	1.00	1.00	1.00
2015	0.73	0.74	0.73
2020	0.50	0.52	0.49
2025/30	n.a.	n.a.	n.a.

Altitude factor (fh)
Unfortunately there is no data available concerning an altitude factor.

3.2. EMISSION FACTORS FOR ALGERIA

According to the simplified method, the following emission factors can be used. Base year is the year 2010. Deviations from that year have to be calculated using the appropriate factors for future emissions (ft).

3.1.4. Passenger cars

Base emission factors
The base emission factor quantifies the vehicle-specific tailpipe emission for a certain pollutant as a function of average vehicle speed and road gradient. The factor differs for gasoline and diesel fuelled cars.

TABLE 47 - BASE EMISSION FACTORS FOR CO, PASSENGER CARS							
PC gasoline CO [g/h] 2010							
v [km/h]	Gradient [%]						
	- 6	- 4	- 2	0	2	4	6
0	68.7	68.7	68.7	68.7	68.7	68.7	68.7
10	78.6	83.9	90.0	95.6	102.7	109.6	131.3
20	88.5	99.1	111.3	122.5	136.8	150.4	194.0
30	88.1	103.6	121.9	143.6	167.1	192.0	252.5
40	87.1	107.2	133.2	168.6	210.0	264.9	322.4
50	84.7	109.0	142.8	187.9	246.8	328.5	423.9
60	81.6	108.8	149.4	203.1	279.1	382.2	564.4
70	78.6	107.3	153.4	219.5	317.2	449.8	738.3
80	76.7	106.1	156.6	241.2	372.2	564.6	937.0
90	76.9	107.0	162.3	269.5	452.2	757.5	1,160.8
100	80.1	112.1	175.0	304.0	561.7	1,045.5	1,414.0
110	86.7	123.6	198.8	345.5	705.4	1,421.9	1,760.4
120	96.3	143.8	237.4	403.5	895.6	1,811.4	2,273.0
130	107.2	174.7	291.7	504.7	1,163.4	2,202.3	3,011.6

TABLE 48 - BASE EMISSION FACTORS FOR NO_X, PASSENGER CARS							
PC Gasoline NO_x [g/h] 2010							
v [km/h]	Gradient [%]						
	- 6	- 4	- 2	0	2	4	6
0	4.2	4.2	4.2	4.2	4.2	4.2	4.2
10	8.8	8.8	8.8	12.0	14.4	16.2	17.8
20	8.8	8.8	9.1	14.7	17.6	25.1	35.0
30	8.8	8.8	10.9	16.8	25.7	37.4	43.3
40	8.8	8.8	11.8	19.1	34.1	43.0	49.5
50	8.8	8.8	12.0	22.8	39.3	47.7	54.7
60	8.8	8.8	13.6	29.0	44.1	52.9	67.1
70	8.8	8.8	15.8	37.7	49.1	61.1	84.8
80	8.8	8.8	18.9	42.7	54.2	76.6	104.7
90	8.8	8.8	28.0	47.8	64.0	94.3	126.7
100	8.8	12.0	38.6	53.5	80.8	115.6	152.7
110	8.8	17.4	45.3	64.2	100.8	140.3	182.2
120	8.8	30.8	52.1	83.1	124.4	168.7	215.6
130	10.2	42.2	63.3	105.7	152.0	201.4	253.3

TABLE 49 - BASE EMISSION FACTORS FOR CO PASSENGER CARS							
PC Diesel CO [g/h] 2010							
v [km/h]	Gradient [%]						
	- 6	- 4	- 2	0	2	4	6
0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
10	5.4	5.4	5.4	6.5	6.6	8.7	10.0
20	5.4	5.4	5.6	6.7	6.8	7.1	7.4
30	5.4	5.4	6.0	7.1	7.3	7.6	7.4
40	5.4	5.4	6.2	7.5	7.9	7.6	5.8
50	5.4	5.4	6.0	8.0	7.8	6.3	4.9
60	5.4	5.4	6.3	8.1	7.6	5.3	4.7
70	5.4	5.4	7.2	8.1	6.3	4.5	5.4
80	5.4	5.4	8.6	8.1	5.3	5.0	6.1
90	5.4	5.4	9.5	7.1	4.6	5.6	6.9
100	5.4	5.4	8.9	5.8	4.9	6.4	7.7
110	5.4	5.7	7.9	4.8	5.7	7.2	8.6
120	5.4	8.8	6.8	4.8	6.4	8.0	9.6
130	5.4	6.9	5.3	5.6	7.3	9.0	10.6

TABLE 50 - BASE EMISSION FACTORS FOR NO_x, PASSENGER CARS							
PC Diesel NO_x [g/h] 2010							
v [km/h]	Gradient [%]						
	-6	-4	-2	0	2	4	6
0	7.3	7.3	7.3	7.3	7.3	7.3	7.3
10	7.0	7.0	7.0	12.3	16.6	20.3	24.2
20	7.0	7.0	8.0	17.3	23.7	29.1	38.0
30	7.0	7.0	10.2	21.6	29.4	40.2	53.9
40	7.0	7.0	10.8	24.6	35.9	52.0	71.4
50	7.0	7.0	11.2	26.3	42.3	64.4	87.9
60	7.0	7.0	11.6	29.4	52.4	80.0	109.1
70	7.0	7.0	15.1	36.0	65.4	97.6	134.3
80	7.0	7.0	20.2	44.8	80.1	118.8	161.7
90	7.0	7.0	25.4	56.3	96.5	142.7	191.6
100	7.0	7.0	32.4	71.6	118.2	170.7	225.8
110	7.0	8.7	43.3	89.8	144.0	202.6	263.8
120	7.0	20.8	59.4	112.6	174.0	238.8	306.3
130	7.0	31.1	80.0	141.1	208.8	279.8	353.7

TABLE 51 - BASE EMISSION FACTORS FOR EXHAUST PARTICLES (OPACITY), PASSENGER CARS							
PC Diesel Opacity [m^2/h] 2010							
v [km/h]	Gradient [%]						
	- 6	- 4	- 2	0	2	4	6
0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
10	1.9	1.9	1.9	3.9	5.7	7.4	9.3
20	1.9	1.9	2.2	6.0	9.1	11.9	15.4
30	1.9	1.9	3.0	8.1	12.1	16.2	21.0
40	1.9	1.9	3.3	9.5	14.6	20.4	26.7
50	1.9	1.9	3.5	10.5	17.0	24.5	31.9
60	1.9	1.9	3.6	12.1	20.5	29.4	37.9
70	1.9	1.9	5.0	14.6	24.8	34.8	44.0
80	1.9	1.9	7.4	17.9	29.5	40.3	50.3
90	1.9	1.9	9.9	21.8	34.5	45.9	56.8
100	1.9	1.9	13.3	26.8	40.1	52.3	63.9
110	1.9	2.4	17.4	32.5	46.3	59.1	71.6
120	1.9	7.6	22.8	38.8	53.0	66.6	79.7
130	1.9	12.8	29.4	45.6	60.4	74.7	88.4

Future years (ft)

The influence of continual fleet renewal and more stringent emission standards for new vehicles is taken into consideration by the factor ft.

TABLE 52 - INFLUENCING FACTOR (FT) FOR YEARS DIFFERENT TO THE BASE YEAR					
ft	**CO**		**NO_x**		**Opacity**
Passenger cars	Gasoline	Diesel	Gasoline	Diesel	Diesel
2010	1.00	1.00	1.00	1.00	1.00
2015	0.69	0.60	0.67	0.83	0.56
2020	0.47	0.47	0.43	0.77	0.40
2025	0.30	0.41	0.26	0.75	0.34
2030	n.a.	n.a.	n.a.	n.a.	n.a.

Altitude factor (fh)

Unfortunately there is no data available concerning an altitude factor.

3.1.5. Light-Duty Vehicles

The base emission factor quantifies the vehicle specific tailpipe emission for a certain pollutant as a function of average vehicle speed and road gradient.

If the vehicle split is given in HGV and PC, the PC proportion can be further divided into passenger cars (PC) and Light-Duty vehicles (LDV) according to the values given in *table 53*. *Table 54* indicates the percentage of gasoline and diesel fuelled LDV.

TABLE 53 - PERCENTAGE OF LIGHT-DUTY VEHICLES AND PASSENGER CARS (FLEET MIX)	
Percentage LDV / PC	
LDV	PC
25 %	75 %

TABLE 54 - PERCENTAGE OF DIESEL AND GASOLINE LDV	
Percentage LDV (average 2010 – 2030)	
Diesel	Gasoline
49 %	51 %

The proportion of diesel and gasoline fuelled vehicles given in *table 54* was used to calculate the base emission factors and influencing factors given below.

TABLE 55 - BASE EMISSION FACTORS FOR CO, LIGHT-DUTY VEHICLES (DIESEL/GASOLINE MIX)							
LDV CO [g/h] 2010							
v [km/h]	Gradient [%]						
	- 6	- 4	- 2	0	2	4	6
0	20.5	20.5	20.5	20.5	20.5	20.5	20.5
10	49.6	49.6	55.2	109.1	149.9	187.3	144.5
20	49.6	49.6	77.7	162.3	144.7	78.8	93.4
30	49.6	49.6	104.1	174.2	74.6	117.4	222.1
40	49.6	49.6	127.6	107.6	98.3	227.4	425.8
50	49.6	49.6	137.9	80.1	160.3	369.9	686.1
60	49.6	49.6	172.5	83.2	276.0	612.9	966.2
70	49.6	49.6	148.2	155.8	465.7	888.7	1,305.1
80	49.6	49.6	120.0	279.1	741.6	1,190.4	1,713.1
90	49.6	113.7	108.8	473.4	998.8	1,553.1	2,192.8
100	49.6	157.3	235.1	779.2	1,348.2	2,024.5	2,797.0
110	49.6	170.0	467.3	1,095.2	1,789.5	2,601.9	3,520.8
120	128.3	195.6	813.9	1,503.9	2,338.4	3,301.0	3,774.7
130	130.0	455.8	1,185.1	2,021.1	3,010.7	3,460.0	4,087.1

TABLE 56 - BASE EMISSION FACTORS FOR NO_x, LIGHT-DUTY VEHICLES (DIESEL/GASOLINE MIX)							
LDV NO_x [g/h] 2010							
v [km/h]	Gradient [%]						
	- 6	- 4	- 2	0	2	4	6
0	9.4	9.4	9.4	9.4	9.4	9.4	9.4
10	9.0	9.0	10.1	23.0	35.6	49.0	43.2
20	9.0	9.0	15.0	39.8	43.2	30.1	35.1
30	9.0	9.0	21.6	49.0	29.3	40.9	62.1
40	9.0	9.0	28.4	35.9	36.3	61.4	94.5
50	9.0	9.0	31.6	30.4	50.2	86.3	128.5
60	9.0	9.0	43.5	32.4	71.4	119.5	163.9
70	9.0	9.0	43.9	49.2	86.0	154.3	203.9
80	9.0	9.0	29.6	72.0	120.0	190.7	249.1
90	9.0	19.1	38.8	101.2	167.9	231.7	299.4
100	9.0	20.6	64.4	140.3	208.8	282.0	359.5
110	9.0	31.5	100.4	179.5	257.3	340.4	428.3
120	28.6	57.1	144.8	226.3	314.1	407.7	455.3
130	31.4	98.8	190.1	281.7	380.1	422.9	490.6

TABLE 57 - BASE EMISSION FACTORS FOR PM (OPACITY), LIGHT-DUTY VEHICLES (DIESEL/GASOLINE MIX)							
LDV Opacity [m²/h] 2010							
v [km/h]	Gradient [%]						
	- 6	- 4	- 2	0	2	4	6
0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
10	0.9	0.9	1.0	2.4	3.6	4.7	5.9
20	0.9	0.9	1.6	4.0	5.9	7.9	10.0
30	0.9	0.9	2.3	5.4	8.1	10.9	13.9
40	0.9	0.9	2.9	6.8	10.2	13.6	17.7
50	0.9	0.9	3.2	7.8	12.3	16.8	21.4
60	0.9	0.9	4.3	9.6	15.1	20.4	25.8
70	0.9	0.9	5.8	12.2	18.3	24.6	30.8
80	0.9	0.9	8.0	15.2	22.2	29.2	36.0
90	0.9	2.6	10.6	18.4	26.3	34.0	41.5
100	0.9	5.7	14.2	22.8	31.3	39.7	47.8
110	0.9	9.1	18.3	27.8	36.9	45.9	54.7
120	3.0	13.3	23.4	33.4	43.1	52.7	57.7
130	7.6	18.2	29.1	39.6	49.9	54.2	62.0

Future years (ft)

The influence of continual fleet renewal and more stringent emission standards for new vehicles is taken into consideration by the factor ft.

TABLE 58 - INFLUENCING FACTOR (FT) FOR YEARS DIFFERENT TO THE BASE-YEAR, LDV (DIESEL/GASOLINE MIX)			
ft	CO	NO_x	Opacity
LDV	Diesel/Gasoline Mix	Diesel/Gasoline Mix	Diesel/Gasoline Mix
2010	1.00	1.00	1.00
2015	0.65	0.77	0.74
2020	0.43	0.64	0.59
2025	0.33	0.55	0.47
2030	n.a.	n.a.	n.a.

Altitude factor (fh)

Unfortunately there is no data available regarding an altitude factor.

3.2.3. Trucks

The base emission factor quantifies the vehicle specific tailpipe emission for a certain pollutant as a function of average vehicle speed and road gradient. The factors only exist for diesel HGVs.

TABLE 59 - BASE EMISSION FACTORS FOR CO (EC EURO REGULATION), HEAVY-GOODS VEHICLES DIESEL (AVERAGE MASS OF 23 t)

HGV DIESEL CO [g/h] 2010							
v [km/h]	Gradient [%]						
	- 6	- 4	- 2	0	2	4	6
0	44.5	44.5	44.5	44.5	44.5	44.5	44.5
10	33.1	37.7	55.4	67.0	74.0	81.8	89.9
20	23.3	34.3	57.7	71.3	82.8	99.8	116.5
30	21.2	33.4	63.7	76.8	94.7	121.7	145.6
40	19.1	32.2	65.7	81.8	108.6	143.6	173.4
50	19.1	29.4	64.2	85.6	124.6	164.1	204.1
60	19.1	25.2	59.7	90.4	141.0	185.8	235.7
70	19.1	20.5	55.3	97.8	156.0	209.4	268.8
80	19.1	21.5	60.7	109.9	173.6	235.5	304.7
90	19.1	23.8	67.3	126.0	192.2	262.0	340.6
100	19.1	28.4	77.5	144.1	211.1	288.6	376.3
110	19.1	32.6	87.9	159.5	229.0	315.0	411.8
120	19.5	49.0	100.8	171.2	247.0	341.0	447.0
130	22.5	55.2	116.6	181.5	264.9	366.8	482.7

TABLE 60 - BASE EMISSION FACTORS FOR NO_X, HEAVY-GOODS VEHICLES DIESEL (AVERAGE MASS OF 23 t)

HGV DIESEL NO_X [g/h] 2010							
v [km/h]	Gradient [%]						
	- 6	- 4	- 2	0	2	4	6
0	89.5	89.5	89.5	89.5	89.5	89.5	89.5
10	58.0	70.8	140.6	201.8	256.9	328.4	401.6
20	36.7	62.0	160.0	232.1	340.1	489.1	625.3
30	32.6	63.6	185.3	280.5	445.0	667.4	873.8
40	29.1	56.4	195.2	326.5	558.8	852.8	1,118.5
50	29.1	49.2	188.9	360.7	688.7	1,035.5	1,377.7
60	29.1	38.4	166.3	402.7	826.2	1,226.9	1,640.8
70	29.1	30.8	147.6	469.3	962.3	1,433.1	1,906.8
80	29.1	32.3	176.2	566.6	1,122.0	1,643.7	2,175.0
90	29.1	36.4	217.7	689.9	1,283.7	1,846.4	2,440.5
100	29.1	47.9	287.1	842.5	1,440.2	2,044.0	2,703.9
110	29.1	68.4	375.0	991.5	1,579.5	2,239.1	2,965.6
120	29.8	119.4	483.6	1,103.1	1,714.7	2,432.5	3,225.9
130	39.0	180.5	606.5	1,187.6	1,847.5	2,623.9	3,486.0

TABLE 61 - BASE EMISSION FACTORS FOR PM (OPACITY), HEAVY-GOODS VEHICLES DIESEL (AVERAGE MASS OF 23 t)							
HGV Diesel Opacity [m²/h] 2010							
v [km/h]	Gradient [%]						
	- 6	- 4	- 2	0	2	4	6
0	40.6	40.6	40.6	40.6	40.6	40.6	40.6
10	25.1	27.1	39.2	48.8	56.2	64.5	71.9
20	17.7	26.9	43.3	52.9	65.8	80.3	95.0
30	16.0	26.1	46.8	59.0	76.0	99.7	122.4
40	14.4	24.2	48.3	64.4	87.7	120.3	149.0
50	14.4	22.9	47.5	68.1	102.2	140.0	178.1
60	14.4	20.8	44.8	72.3	117.6	160.9	207.8
70	14.4	17.9	41.0	78.5	132.2	183.6	238.4
80	14.4	16.6	45.2	88.6	149.3	207.9	270.8
90	14.4	18.9	51.7	102.9	167.3	232.0	303.0
100	14.4	23.5	59.6	120.0	185.1	255.9	335.0
110	14.4	24.9	69.4	135.7	201.4	279.5	366.9
120	14.6	37.8	80.9	147.3	217.7	302.9	398.5
130	17.0	44.6	94.3	157.0	233.8	326.1	430.4

HGV Type dependent factor (fm)

The emission factors given are calculated for the fleet mix of heavy-goods vehicles. This fleet mix consists of single lorries, trailer trucks and coaches, whereas coaches can be related to single lorries.

TABLE 62 - PERCENTAGE VARIATION OF HEAVY-GOODS VEHICLES ALGERIA (AVERAGE MIX)	
Type	Percentage
15 t Single lorry	58%
32 t Truck – trailer combination/semitrailers	42%

TABLE 63 - HGV-TYPE DEPENDENT FACTOR (fm) TO THE AVERAGE EMISSION FACTORS FOR DIFFERENT TYPES OF HGV			
Type	CO	NO_X	Opacity
15 t Single lorry*	0,7	0,7	0,7
32 t Truck – trailer combination/semitrailers	1,9	1,9	1,9
* including coaches			

Future years (ft)
The influence of continual fleet renewal and more stringent emission standards for new vehicles is taken into consideration by the factor ft.

TABLE 64: INFLUENCING FACTOR (FT) FOR YEARS DIFFERENT TO THE BASE-YEAR, HEAVY-GOODS VEHICLES			
Year	**CO**	**NO_x**	**Opacity**
2010	1.00	1.00	1.00
2015	0.55	0.65	0.55
2020	0.37	0.50	0.37
2025	0.28	0.43	0.28
2030	n.a.	n.a.	n.a.

Altitude factor (fh)
Unfortunately there is no data available concerning an altitude factor.

3.3. EMISSION FACTORS FOR CHINA

According to the simplified method, the following emission factors can be used. Base year is the year 2007. Deviations from that year have to be calculated using appropriate factors for future emissions (ft). Due to lack in data about future fleet compositions in China, specific influencing factors ft cannot be given yet.

3.3.1. Passenger cars

Base emission factors
The base emission factor quantifies the vehicle specific tailpipe emission for a certain pollutant as a function of average vehicle speed and road gradient. The factor differs for gasoline and diesel fuelled cars.

TABLE 65 - BASE EMISSION FACTORS FOR CO, PASSENGER CARS							
PC gasoline CO [g/h] 2007							
v [km/h]	Gradient [%]						
	- 6	- 4	- 2	0	2	4	6
0	31.7	31.7	31.7	31.7	31.7	31.7	31.7
10	37.3	40.1	43.6	47.1	52.4	59.3	70.5
20	42.9	48.5	55.5	62.4	73.0	86.9	109.3
30	43.1	51.7	62.6	76.6	94.2	115.4	154.5
40	43.2	54.9	71.1	94.5	124.6	166.1	219.9
50	42.5	56.9	78.3	109.3	153.6	219.2	304.7
60	41.4	57.5	83.1	121.3	181.3	269.3	408.2
70	40.4	57.4	86.3	133.9	213.2	325.5	531.7
80	40.4	57.9	89.7	150.3	255.6	409.2	679.7
90	41.8	60.3	96.3	172.3	313.8	546.9	858.9
100	44.5	65.9	108.9	200.1	392.2	760.3	1,077.0
110	48.0	75.2	129.1	233.8	495.9	1,052.0	1,339.4
120	51.2	87.7	156.1	277.2	634.9	1,313.0	1,691.9
130	52.9	101.4	184.7	341.7	829.1	1,588.7	2,097.6

TABLE 66 - BASE EMISSION FACTORS FOR NO_X , PASSENGER CARS							
PC Gasoline NO_x [g/h] 2007							
v [km/h]	Gradient [%]						
	- 6	- 4	- 2	0	2	4	6
0	2.8	2.8	2.8	2.8	2.8	2.8	2.8
10	5.9	5.9	5.9	8.0	9.5	10.7	11.8
20	5.9	5.9	6.1	9.7	11.6	16.6	23.1
30	5.9	5.9	7.2	11.1	17.0	24.7	28.6
40	5.9	5.9	7.8	12.6	22.5	28.4	32.7
50	5.9	5.9	8.0	15.1	26.0	31.5	36.1
60	5.9	5.9	9.0	19.2	29.2	35.0	44.3
70	5.9	5.9	10.4	24.9	32.5	40.3	55.9
80	5.9	5.9	12.5	28.2	35.8	50.6	69.0
90	5.9	5.9	18.5	31.6	42.2	62.2	83.4
100	5.9	7.9	25.5	35.3	53.3	76.1	100.4
110	5.9	11.5	29.9	42.4	66.4	92.3	119.7
120	5.9	20.3	34.4	54.8	81.9	110.9	141.6
130	6.8	27.9	41.8	69.7	100.0	132.3	166.3

TABLE 67 - BASE EMISSION FACTORS FOR CO (EC EURO REGULATION), PASSENGER CARS							
PC Diesel CO [g/h] 2007							
v [km/h]	Gradient [%]						
	- 6	- 4	- 2	0	2	4	6
0	4.2	4.2	4.2	4.2	4.2	4.2	4.2
10	11.8	11.8	11.8	12.4	12.9	13.2	13.6
20	11.8	11.8	11.9	12.9	13.5	13.4	15.7
30	11.8	11.8	12.2	13.3	13.5	16.3	15.8
40	11.8	11.8	12.3	13.6	15.2	16.3	11.9
50	11.8	11.8	12.2	13.4	16.0	13.2	9.7
60	11.8	11.8	12.4	13.5	16.2	10.7	9.0
70	11.8	11.8	12.7	15.2	17.0	8.8	10.2
80	11.8	11.8	13.2	15.5	17.5	9.5	11.4
90	11.8	11.8	13.5	15.5	18.0	19.0	20.0
100	11.8	11.8	13.5	15.5	18.0	19.0	20.0
110	11.8	12.0	13.5	15.5	18.0	19.0	20.0
120	11.8	13.3	13.5	15.5	18.0	19.0	20.0
130	11.8	13.9	13.5	15.5	18.0	19.0	20.0

TABLE 68 - BASE EMISSION FACTORS FOR NO_X, PASSENGER CARS							
VP Diesel NO_x [g/h] 2007							
v [km/h]	Gradient [%]						
	- 6	- 4	- 2	0	2	4	6
0	9.1	9.1	9.1	9.1	9.1	9.1	9.1
10	8.1	8.1	8.1	13.9	18.3	22.2	26.1
20	8.1	8.1	9.2	19.1	25.5	31.2	40.8
30	8.1	8.1	11.6	23.5	31.6	43.2	57.4
40	8.1	8.1	12.2	26.4	38.6	55.5	75.0
50	8.1	8.1	11.2	28.3	45.4	68.0	91.2
60	8.1	8.1	13.1	31.5	55.9	83.5	112.7
70	8.1	8.1	16.7	38.7	69.0	100.7	139.4
80	8.1	8.1	22.0	48.0	83.6	122.9	168.7
90	8.1	8.1	27.3	59.9	99.7	148.3	200.6
100	8.1	8.1	34.8	75.2	122.3	178.3	237.3
110	8.1	9.9	46.5	93.1	149.7	212.4	278.3
120	8.1	22.6	62.9	116.3	181.8	251.3	324.2
130	8.1	33.4	83.5	146.6	219.0	295.6	375.5

TABLE 69 - BASE EMISSION FACTORS FOR EXHAUST PARTICLES (OPACITY), PASSENGER CARS							
PC Diesel Opacity [m²/h] 2007							
v [km/h]	Gradient [%]						
	- 6	- 4	- 2	0	2	4	6
0	2.9	2.9	2.9	2.9	2.9	2.9	2.9
10	2.5	2.5	2.5	5.6	8.4	11.2	14.2
20	2.5	2.5	3.0	9.0	13.8	18.5	23.8
30	2.5	2.5	4.3	12.2	18.7	25.1	32.3
40	2.5	2.5	4.6	14.5	22.6	31.4	40.4
50	2.5	2.5	4.1	16.1	26.3	37.3	47.7
60	2.5	2.5	5.1	18.7	31.6	44.3	56.5
70	2.5	2.5	7.4	22.7	37.7	51.8	66.3
80	2.5	2.5	11.1	27.7	44.3	60.3	76.5
90	2.5	2.5	15.2	33.5	51.3	69.5	87.2
100	2.5	2.5	20.5	40.5	60.1	79.8	99.0
110	2.5	3.4	26.9	48.5	70.0	91.1	111.6
120	2.5	11.5	34.9	57.8	81.0	103.4	125.2
130	2.5	19.7	44.3	68.9	93.2	116.8	139.9

Future years (ft)
The influence of continual fleet renewal and more stringent emission standards for new vehicles is taken into consideration by the factor ft. Due to the lack of data about future fleet compositions in China, specific influencing factors ft cannot be given yet.

Altitude factor (fh)
Due to the lack of data about altitude influences on Chinese vehicles, specific influencing factors ft cannot be given yet.

3.3.2. Light-Duty Vehicles

The base emission factor quantifies the vehicle-specific tailpipe emission for a certain pollutant as a function of average vehicle speed and road gradient.

A proportional distribution between PC and LDV is not given. *Table 70, following page,* indicates the percentage of gasoline and diesel fuelled LDV.

TABLE 70 - PERCENTAGE OF DIESEL AND GASOLINE LDV	
Percentage LDV (average 2007 – 2030)	
Diesel	Gasoline
50%	50%

The proportion of diesel and gasoline fuelled vehicles given in *table 70* was used to calculate the base emission factors and influencing factors given below.

TABLE 71 - BASE EMISSION FACTORS FOR CO, LIGHT-DUTY VEHICLES (DIESEL/GASOLINE MIX)							
LDV CO [g/h] 2007							
v [km/h]	**Gradient [%]**						
	- 6	**- 4**	**- 2**	**0**	**2**	**4**	**6**
0	4.7	4.7	4.7	4.7	4.7	4.7	4.7
10	33.7	33.7	37.1	68.8	82.3	85.7	89.1
20	33.7	33.7	50.5	99.4	89.2	87.9	100.0
30	33.7	33.7	65.9	106.1	110.4	120.0	129.9
40	33.7	33.7	79.5	110.0	120.4	132.9	241.5
50	33.7	33.7	85.4	120.0	150.8	210.9	383.7
60	33.7	33.7	105.2	130.0	159.5	343.7	536.1
70	33.7	33.7	110.0	140.0	263.3	493.9	720.4
80	33.7	33.7	120.0	161.1	413.9	658.0	942.1
90	33.7	71.5	130.0	267.6	553.8	855.2	1,202.8
100	33.7	96.5	137.0	434.4	743.8	1,111.3	1,530.9
110	33.7	100.0	264.2	606.2	983.7	1,425.0	1,924.0
120	79.9	115.3	453.2	828.4	1,281.8	1,804.7	2,062.3
130	54.7	257.9	655.1	1,109.5	1,647.0	1,891.1	2,232.7

TABLE 72 - BASE EMISSION FACTORS FOR NO_x, LIGHT-DUTY VEHICLES (DIESEL/GASOLINE MIX)							
LDV NO_x [g/h] 2007							
v [km/h]	Gradient [%]						
	- 6	- 4	- 2	0	2	4	6
0	8.5	8.5	8.5	8.5	8.5	8.5	8.5
10	9.9	9.9	10.9	21.4	31.0	25.0	37.5
20	9.9	9.9	15.0	34.2	37.5	29.1	34.6
30	9.9	9.9	20.4	41.3	37.0	40.0	59.2
40	9.9	9.9	25.6	32.8	35.8	60.1	88.1
50	9.9	9.9	28.0	29.3	48.5	80.8	117.7
60	9.9	9.9	36.9	32.2	67.6	109.9	152.8
70	9.9	9.9	38.0	47.6	68.4	143.1	194.1
80	9.9	9.9	38.8	68.1	92.9	180.4	241.6
90	9.9	22.5	38.1	93.9	156.9	223.2	295.3
100	9.9	27.0	61.3	129.0	199.3	276.7	360.5
110	9.9	29.6	93.2	168.8	250.3	339.7	436.2
120	25.8	54.8	133.5	217.5	311.2	413.5	464.9
130	29.9	91.8	179.7	276.3	383.1	430.2	501.6

TABLE 73 - BASE EMISSION FACTORS FOR PM (OPACITY), LIGHT-DUTY VEHICLES (DIESEL/GASOLINE MIX)							
LDV Opacity [m²/h] 2007							
v [km/h]	Gradient [%]						
	- 6	- 4	- 2	0	2	4	6
0	6.3	6.3	6.3	6.3	6.3	6.3	6.3
10	1.4	1.4	1.6	3.9	5.8	7.7	9.7
20	1.4	1.4	2.5	6.4	9.7	12.9	16.4
30	1.4	1.4	3.7	8.9	13.3	17.9	22.7
40	1.4	1.4	4.8	11.1	16.7	22.9	28.7
50	1.4	1.4	5.2	12.8	20.1	27.3	34.6
60	1.4	1.4	6.9	15.7	24.5	33.1	42.0
70	1.4	1.4	9.6	19.9	29.7	40.0	50.1
80	1.4	1.4	13.1	24.6	36.0	47.5	58.7
90	1.4	4.1	17.4	29.9	42.8	55.4	67.8
100	1.4	9.3	23.1	37.0	51.0	64.7	78.1
110	1.4	14.9	29.7	45.2	60.2	74.9	89.4
120	4.8	21.6	38.0	54.4	70.4	86.1	94.4
130	12.4	29.4	47.3	64.6	81.6	88.6	101.3

Future years (ft)

The influence of continual fleet renewal and more stringent emission standards for new vehicles is taken into consideration by the factor ft. Due to the lack of data about future fleet compositions in China, specific influencing factor ft cannot be given yet.

Altitude factor (fh)

Due to the lack of data about altitude influences on Chinese vehicles, specific influencing factor fh cannot be given yet.

3.3.3. Trucks

The base emission factor quantifies the vehicle specific tailpipe emission for a certain pollutant as a function of average vehicle speed and road gradient. The factors only exist for diesel HGVs.

TABLE 74 - BASE EMISSION FACTORS FOR CO HEAVY-GOODS VEHICLES DIESEL (AVERAGE MASS OF 23 t)

HGV Diesel CO [g/h] 2010							
v [km/h]	Gradient [%]						
	- 6	- 4	- 2	0	2	4	6
0	45.7	45.7	45.7	45.7	45.7	45.7	45.7
10	35.2	40.1	58.1	68.5	76.7	87.1	96.8
20	25.6	36.4	55.6	73.1	88.7	107.4	125.1
30	23.4	37.3	66.0	79.9	101.9	130.5	156.6
40	21.4	34.3	67.7	86.8	116.5	154.3	186.9
50	21.4	31.6	66.6	91.7	133.6	176.7	220.2
60	21.4	27.4	62.4	97.2	151.4	200.3	254.7
70	21.4	22.7	57.4	105.1	167.8	226.1	290.5
80	21.4	23.7	62.4	117.5	186.9	254.5	329.6
90	21.4	26.0	70.5	134.6	207.3	283.3	368.4
100	21.4	31.1	81.0	154.2	227.9	312.0	407.1
110	21.4	34.9	93.1	171.2	247.3	340.5	445.5
120	21.7	49.4	106.8	184.1	266.9	368.7	483.6
130	25.0	59.1	123.5	195.4	286.2	396.7	522.2

TABLE 75 - BASE EMISSION FACTORS FOR NO_X, HEAVY-GOODS VEHICLES DIESEL (AVERAGE MASS OF 23 t)							
HGV Diesel NO_x [g/h] 2010							
v [km/h]	Gradient [%]						
	- 6	- 4	- 2	0	2	4	6
0	90.1	90.1	90.1	90.1	90.1	90.1	90.1
10	58.4	72.0	140.8	203.2	263.5	342.0	421.4
20	36.7	61.4	160.9	236.5	354.7	514.0	655.8
30	32.6	64.1	185.7	286.0	467.6	699.7	913.3
40	29.2	56.9	196.4	339.9	586.9	891.7	1166.6
50	29.2	49.7	190.1	377.4	721.7	1080.6	1435.2
60	29.2	38.7	169.7	422.7	864.1	1278.9	1707.8
70	29.2	30.8	149.3	493.8	1005.0	1492.2	1983.3
80	29.2	32.5	178.1	595.1	1170.4	1710.2	2261.9
90	29.2	36.7	225.9	723.1	1337.9	1920.2	2537.5
100	29.2	49.3	296.9	881.1	1498.8	2125.4	2811.3
110	29.2	69.3	390.2	1033.9	1642.1	2328.0	3083.1
120	29.9	119.1	505.3	1146.9	1783.0	2528.7	3353.5
130	39.7	189.8	632.2	1235.1	1920.9	2727.5	3623.7

TABLE 76 - BASE EMISSION FACTORS FOR PM (OPACITY), HGV DIESEL (AVERAGE MASS OF 23 t)							
HGV Diesel Opacity [m²/h] 2007							
v [km/h]	Gradient [%]						
	- 6	- 4	- 2	0	2	4	6
0	47.6	47.6	47.6	47.6	47.6	47.6	47.6
10	27.8	32.3	45.8	54.3	62.7	71.0	78.6
20	18.6	30.7	47.8	58.6	72.3	87.4	103.7
30	16.6	29.6	53.2	64.6	82.7	108.9	135.5
40	14.8	26.9	54.7	70.9	95.4	132.9	166.6
50	14.8	24.8	53.9	74.7	111.8	156.1	200.4
60	14.8	21.5	51.0	78.9	129.7	180.5	235.0
70	14.8	18.3	46.3	85.3	146.8	207.0	270.3
80	14.8	17.1	50.7	95.9	166.9	235.1	307.3
90	14.8	19.6	58.3	112.2	188.0	262.7	344.1
100	14.8	24.9	65.9	132.0	208.5	290.0	380.6
110	14.8	27.1	76.4	150.4	227.3	317.0	416.9
120	15.0	39.7	88.5	164.1	245.9	343.6	453.0
130	17.9	49.3	102.9	175.4	264.2	370.2	489.3

HGV-type dependent factor

The emission factors given are calculated for the fleet mix of heavy-goods vehicles with an average gross weight of 23 t. This fleet mix consists of single lorries, trailer trucks and coaches, whereas coaches can be related to single lorries. Due to missing data, the percentage distribution of heavy goods vehicles with other weight classes cannot be provided.

TABLE 77 - HGV-TYPE DEPENDENT FACTOR (FM) TO THE AVERAGE EMISSION FACTORS FOR DIFFERENT TYPES OF HGV

Type	CO	NO_x	Opacity
15 t Single lorry*	0.7	0.7	0.7
32 t Truck – trailer combination/semitrailers	1.9	1.9	1.9
* including coaches			

Future years (ft)

The influence of continual fleet renewal and more stringent emission standards for new vehicles is taken into consideration by the factor ft. Due to the lack of data about future fleet compositions in China, specific influencing factors ft cannot be given yet.

Altitude factor (fh)

Due to the lack of data about altitude influences on Chinese vehicles, specific influencing factor fh cannot be given yet.

4. EMISSION TABLES FOR EURO STANDARDS AND ADDITIONAL INFORMATION

4.1. PC GASOLINE NO_X

Gradient [%]: 0														
v [km/h]	**0**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**	**110**	**120**	**130**
standard	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h
Pre EURO	6.97	20.20	24.74	28.27	32.10	38.36	48.82	63.38	71.84	80.38	89.85	108.02	139.91	178.36
EURO 1	2.14	6.84	8.37	9.57	10.87	12.98	16.52	21.45	24.31	27.21	30.41	36.56	47.35	60.37
EURO 2	1.70	3.42	4.19	4.78	5.43	6.49	8.26	10.73	12.16	13.60	15.21	18.28	23.68	30.18
EURO 3	0.41	1.65	1.83	1.96	2.16	2.58	3.28	4.27	4.94	5.63	6.41	7.42	8.73	10.18
EURO 4	0.32	0.68	0.75	0.81	0.89	1.06	1.35	1.76	2.03	2.32	2.64	3.05	3.59	4.19
EURO 5	0.30	0.63	0.69	0.74	0.82	0.98	1.24	1.62	1.87	2.13	2.43	2.81	3.31	3.86
EURO 6	0.28	0.59	0.66	0.71	0.78	0.93	1.18	1.54	1.78	2.03	2.31	2.67	3.14	3.66
Gradient [%]: - 6														
v [km/h]	**0**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**	**110**	**120**	**130**
standard	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h
Pre EURO	6.97	14.73	14.73	14.73	14.73	14.73	14.73	14.73	14.73	14.73	14.73	14.73	14.73	17.04
EURO 1	2.14	4.99	4.99	4.99	4.99	4.99	4.99	4.99	4.99	4.99	4.99	4.99	4.98	5.77
EURO 2	1.70	2.49	2.49	2.49	2.49	2.49	2.49	2.49	2.49	2.49	2.49	2.49	2.49	2.88
EURO 3	0.41	1.40	1.40	1.40	1.40	1.40	1.40	1.40	1.40	1.40	1.40	1.40	1.40	1.51
EURO 4	0.32	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.62
EURO 5	0.30	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.57
EURO 6	0.28	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.50	0.51	0.50	0.51	0.54
Gradient [%]: - 4														
v [km/h]	**0**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**	**110**	**120**	**130**
standard	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h
Pre EURO	6.97	14.73	14.73	14.73	14.73	14.73	14.73	14.73	14.73	14.73	20.06	29.19	51.85	70.99
EURO 1	2.14	4.99	4.99	4.99	4.99	4.99	4.99	4.99	4.99	4.99	6.79	9.88	17.55	24.03
EURO 2	1.70	2.49	2.49	2.49	2.49	2.49	2.49	2.49	2.49	2.49	3.40	4.94	8.78	12.01
EURO 3	0.41	1.40	1.40	1.40	1.40	1.40	1.40	1.40	1.40	1.40	1.65	2.00	3.48	4.87
EURO 4	0.32	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.68	0.82	1.43	2.00
EURO 5	0.30	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.62	0.76	1.32	1.85
EURO 6	0.28	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.50	0.59	0.72	1.25	1.75

Gradient [%]: - 2														
v [km/h]	**0**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**	**110**	**120**	**130**
standard	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h
Pre EURO	6.97	14.73	15.28	18.20	19.85	20.19	22.88	26.54	31.86	47.13	64.98	76.19	87.56	106.38
EURO 1	2.14	4.99	5.17	6.16	6.72	6.83	7.74	8.98	10.78	15.95	21.99	25.79	29.63	36.00
EURO 2	1.70	2.49	2.59	3.08	3.36	3.42	3.87	4.49	5.39	7.98	11.00	12.89	14.82	18.00
EURO 3	0.41	1.40	1.43	1.57	1.64	1.65	1.76	1.90	2.14	3.16	4.40	5.29	6.22	7.34
EURO 4	0.32	0.58	0.59	0.64	0.67	0.68	0.72	0.78	0.88	1.30	1.81	2.18	2.56	3.02
EURO 5	0.30	0.53	0.54	0.59	0.62	0.63	0.67	0.72	0.81	1.20	1.67	2.00	2.36	2.78
EURO 6	0.28	0.51	0.52	0.56	0.59	0.59	0.63	0.68	0.77	1.14	1.58	1.90	2.24	2.64
Gradient [%]: 2														
v [km/h]	**0**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**	**110**	**120**	**130**
standard	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h
Pre EURO	6.97	24.11	29.65	43.29	57.38	66.19	74.24	82.62	91.07	107.59	136.07	169.96	209.99	256.91
EURO 1	2.14	8.16	10.03	14.65	19.42	22.40	25.13	27.96	30.82	36.41	46.05	57.52	71.07	86.95
EURO 2	1.70	4.08	5.02	7.33	9.71	11.20	12.56	13.98	15.41	18.21	23.03	28.76	35.54	43.48
EURO 3	0.41	1.81	2.01	2.91	3.85	4.49	5.13	5.81	6.51	7.40	8.58	9.87	11.28	12.82
EURO 4	0.32	0.74	0.83	1.20	1.58	1.85	2.11	2.39	2.68	3.04	3.53	4.06	4.64	5.27
EURO 5	0.30	0.69	0.76	1.10	1.46	1.70	1.94	2.20	2.47	2.80	3.25	3.74	4.28	4.86
EURO 6	0.28	0.65	0.72	1.05	1.39	1.62	1.85	2.09	2.34	2.66	3.09	3.55	4.06	4.61
Gradient [%]: 4														
v [km/h]	**0**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**	**110**	**120**	**130**
standard	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h
Pre EURO	6.97	27.16	42.23	62.89	72.37	80.20	88.96	102.67	129.05	158.96	195.08	236.94	285.24	340.73
EURO 1	2.14	9.19	14.29	21.29	24.49	27.15	30.11	34.75	43.68	53.80	66.03	80.19	96.54	115.32
EURO 2	1.70	4.60	7.15	10.64	12.25	13.57	15.05	17.38	21.84	26.90	33.02	40.10	48.27	57.66
EURO 3	0.41	1.92	2.84	4.23	4.98	5.62	6.33	7.18	8.30	9.47	10.77	12.18	13.69	15.32
EURO 4	0.32	0.79	1.17	1.74	2.05	2.31	2.61	2.95	3.41	3.89	4.43	5.01	5.63	6.30
EURO 5	0.30	0.73	1.07	1.60	1.89	2.13	2.40	2.72	3.14	3.59	4.08	4.61	5.19	5.81
EURO 6	0.28	0.69	1.02	1.52	1.79	2.02	2.28	2.58	2.99	3.41	3.88	4.38	4.93	5.51
Gradient [%]: 6														
v [km/h]	**0**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**	**110**	**120**	**130**
standard	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h
Pre EURO	6.97	29.95	58.81	72.77	83.23	91.89	112.92	142.86	176.54	213.99	258.01	308.05	364.79	428.98
EURO 1	2.14	10.14	19.90	24.63	28.17	31.10	38.22	48.35	59.75	72.42	87.32	104.26	123.46	145.19
EURO 2	1.70	5.07	9.95	12.31	14.09	15.55	19.11	24.18	29.88	36.21	43.67	52.13	61.74	72.60
EURO 3	0.41	2.02	3.95	5.01	5.86	6.58	7.63	8.85	10.11	11.42	12.85	14.37	16.00	17.72
EURO 4	0.32	0.83	1.62	2.06	2.41	2.71	3.14	3.64	4.16	4.70	5.29	5.91	6.58	7.29
EURO 5	0.30	0.77	1.49	1.90	2.22	2.49	2.89	3.35	3.83	4.33	4.87	5.45	6.06	6.71
EURO 6	0.28	0.73	1.42	1.80	2.11	2.37	2.74	3.18	3.64	4.11	4.63	5.17	5.76	6.38

4.2. PC GASOLINE CO

Gradient [%]: 0														
v [km/h]	**0**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**	**110**	**120**	**130**
standard	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h
Pre EURO	130.83	178.36	225.88	261.33	301.51	332.04	355.69	380.83	414.12	457.30	508.09	565.30	638.01	758.93
EURO 1	2.21	12.96	23.71	34.52	49.52	66.46	82.44	96.11	108.69	123.84	146.32	189.77	289.77	500.00
EURO 2	1.51	13.32	15.69	17.48	19.18	22.08	26.35	32.92	48.64	70.17	99.04	136.96	220.86	400.04
EURO 3	1.48	12.52	14.05	15.20	16.51	19.29	23.51	29.59	43.36	62.18	87.37	120.41	185.78	344.30
EURO 4	1.30	10.98	11.77	12.34	12.79	14.26	16.53	19.44	22.92	28.18	40.21	56.22	108.47	204.68
EURO 5	1.30	10.98	11.77	12.34	12.79	14.26	16.53	19.44	22.92	28.18	40.21	56.22	108.47	204.68
EURO 6	1.30	10.98	11.77	12.34	12.79	14.26	16.53	19.44	22.92	28.18	40.21	56.22	108.47	204.68
Gradient [%]: - 6														
v [km/h]	**0**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**	**110**	**120**	**130**
standard	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h
Pre EURO	130.83	148.00	165.18	164.02	161.47	156.51	149.88	143.28	138.62	137.33	139.77	144.61	148.37	144.97
EURO 1	2.21	15.54	8.87	10.24	11.63	12.87	13.90	14.87	16.11	18.03	20.95	24.79	28.74	30.73
EURO 2	1.51	11.10	8.22	6.82	6.04	5.49	5.20	5.05	5.01	5.09	5.34	5.88	7.09	12.21
EURO 3	1.48	11.22	7.18	4.58	4.51	4.46	4.43	4.41	4.41	4.41	4.44	4.48	4.57	7.95
EURO 4	1.30	11.10	5.56	4.58	4.51	4.46	4.43	4.41	4.41	4.41	4.44	4.48	4.57	11.33
EURO 5	1.30	11.10	5.56	4.58	4.51	4.46	4.43	4.41	4.41	4.41	4.44	4.48	4.57	11.33
EURO 6	1.30	11.10	5.56	4.58	4.51	4.46	4.43	4.41	4.41	4.41	4.44	4.48	4.57	11.33
Gradient [%]: - 4														
v [km/h]	**0**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**	**110**	**120**	**130**
standard	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h
Pre EURO	130.83	157.78	184.72	192.14	130.83	199.18	197.65	193.92	190.03	188.62	192.49	204.13	225.11	255.39
EURO 1	2.21	17.10	11.99	14.97	18.86	22.40	24.77	26.08	27.43	30.65	37.49	48.37	60.84	67.43
EURO 2	1.51	15.69	10.87	9.36	8.51	7.70	7.45	7.64	8.41	10.52	10.09	17.09	24.90	43.05
EURO 3	1.48	10.86	10.35	6.79	6.35	4.64	4.62	4.63	4.79	7.74	8.37	14.34	20.40	35.35
EURO 4	1.30	9.00	10.35	6.79	6.35	4.64	4.62	4.63	4.79	7.74	8.37	11.59	13.90	20.06
EURO 5	1.30	9.00	10.35	6.79	6.35	4.64	4.62	4.63	4.79	7.74	8.37	11.59	13.90	20.06
EURO 6	1.30	9.00	10.35	6.79	6.35	4.64	4.62	4.63	4.79	7.74	8.37	11.59	13.90	20.06
Gradient [%]: - 2														
v [km/h]	**0**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**	**110**	**120**	**130**
standard	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h
Pre EURO	130.83	168.66	206.48	224.34	242.06	257.27	267.79	273.32	276.30	281.79	296.53	327.01	376.72	442.40
EURO 1	2.21	19.39	16.57	22.45	30.83	38.87	44.60	47.95	51.03	57.44	70.75	92.11	116.93	155.00
EURO 2	1.51	14.50	9.91	10.75	11.67	12.03	13.87	16.22	18.69	25.26	35.47	57.52	89.15	132.04
EURO 3	1.48	10.04	10.28	10.70	11.21	11.36	12.56	14.14	15.79	21.80	30.72	49.62	76.91	113.93
EURO 4	1.30	9.60	9.72	9.93	11.21	10.24	10.89	11.72	12.55	15.32	19.46	23.96	34.15	51.63
EURO 5	1.30	9.60	9.72	9.93	11.21	10.24	10.89	11.72	12.55	15.32	19.46	23.96	34.15	51.63
EURO 6	1.30	9.60	9.72	9.93	11.21	10.24	10.89	11.72	12.55	15.32	19.46	23.96	34.15	51.63

Gradient [%]: 2														
v [km/h]	**0**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**	**110**	**120**	**130**
standard	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h
Pre EURO	130.83	189.60	248.37	298.52	368.59	425.56	472.82	529.44	615.60	744.31	919.20	1138.59	1405.73	1745.21
EURO 1	2.21	20.45	38.70	54.80	76.63	110.60	149.96	187.05	220.76	259.03	316.58	407.68	604.54	991.77
EURO 2	1.51	15.64	18.58	24.09	29.56	38.68	54.67	75.87	103.09	137.74	209.95	360.53	604.54	991.77
EURO 3	1.48	14.04	15.96	21.55	27.12	35.36	49.55	68.29	92.28	122.73	180.95	316.42	540.24	902.23
EURO 4	1.30	11.77	12.72	15.59	18.53	21.14	24.44	31.58	43.25	59.70	109.09	193.90	336.06	568.93
EURO 5	1.30	11.77	12.72	15.59	18.53	21.14	24.44	31.58	43.25	59.70	109.09	193.90	336.06	568.93
EURO 6	1.30	11.77	12.72	15.59	18.53	21.14	24.44	31.58	43.25	59.70	109.09	193.90	336.06	568.93
Gradient [%]: 4														
v [km/h]	**0**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**	**110**	**120**	**130**
standard	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h
Pre EURO	130.83	198.62	266.41	335.90	454.23	549.82	625.85	726.90	910.15	1221.18	1674.16	2236.74	2819.33	3268.99
EURO 1	2.21	27.54	52.87	76.75	122.88	184.78	245.94	301.04	364.99	469.91	649.88	913.64	1287.18	1994.68
EURO 2	1.51	17.38	24.06	32.62	50.42	69.91	96.12	128.98	182.15	308.19	507.30	816.12	1287.18	1994.68
EURO 3	1.48	15.19	21.60	30.25	46.22	63.62	86.94	116.06	159.16	273.79	458.06	748.78	1199.65	1887.92
EURO 4	1.30	12.34	15.65	19.83	23.79	29.56	40.97	55.42	97.37	170.36	289.47	479.96	778.98	1240.36
EURO 5	1.30	12.34	15.65	19.83	23.79	29.56	40.97	55.42	97.37	170.36	289.47	479.96	778.98	1240.36
EURO 6	1.30	12.34	15.65	19.83	23.79	29.56	40.97	55.42	97.37	170.36	289.47	479.96	778.98	1240.36
Gradient [%]: 6														
v [km/h]	**0**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**	**110**	**120**	**130**
standard	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h
Pre EURO	130.83	239.24	347.65	437.98	531.91	683.93	907.50	1189.50	1505.43	1835.69	2182.64	2588.69	3155.26	4062.66
EURO 1	2.21	24.75	47.29	104.25	196.08	282.01	366.30	468.21	600.73	758.31	1004.81	1553.56	2357.55	3519.37
EURO 2	1.51	18.95	29.79	50.62	77.41	106.59	144.49	232.16	391.00	635.53	1004.81	1553.56	2357.55	3519.37
EURO 3	1.48	16.56	27.56	46.62	70.65	96.73	130.49	206.84	354.21	584.96	939.13	1473.70	2268.81	3434.82
EURO 4	1.30	12.82	18.80	23.91	33.10	46.00	70.34	128.96	224.74	377.07	614.17	976.51	1521.40	2328.24
EURO 5	1.30	12.82	18.80	23.91	33.10	46.00	70.34	128.96	224.74	377.07	614.17	976.51	1521.40	2328.24
EURO 6	1.30	12.82	18.80	23.91	33.10	46.00	70.34	128.96	224.74	377.07	614.17	976.51	1521.40	2328.24

4.3. PC DIESEL CO

Gradient [%]: 0														
v [km/h]	**0**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**	**110**	**120**	**130**
standard	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h
Pre EURO	6.46	17.56	17.97	18.23	18.39	18.48	19.03	21.74	24.96	21.54	16.94	13.52	12.93	14.77
EURO 1	4.29	11.65	11.92	12.09	12.20	12.26	12.62	14.42	16.56	14.29	11.24	8.97	8.58	9.80
EURO 2	2.18	10.01	10.24	10.39	10.48	10.53	10.84	12.39	14.22	12.27	9.65	7.71	7.37	8.41
EURO 3	0.84	2.83	5.05	7.33	9.10	6.17	3.13	1.77	1.78	1.80	1.81	1.82	2.05	2.56
EURO 4	0.62	2.36	4.22	6.12	7.60	5.16	2.61	1.48	1.49	1.50	1.51	1.52	1.71	2.14
EURO 5	0.58	2.21	3.94	5.72	7.10	4.82	2.44	1.38	1.39	1.40	1.42	1.43	1.60	2.00
EURO 6	0.58	2.21	3.94	5.72	7.10	4.82	2.44	1.38	1.39	1.40	1.42	1.43	1.60	2.00
Gradient [%]: - 6														
v [km/h]	**0**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**	**110**	**120**	**130**
standard	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h
Pre EURO	6.46	16.91	16.91	16.91	16.91	16.91	16.91	16.91	16.91	16.91	16.91	16.91	16.91	16.91
EURO 1	4.29	11.22	11.22	11.22	11.22	11.22	11.22	11.22	11.22	11.22	11.22	11.22	11.22	11.22
EURO 2	2.18	9.64	9.64	9.64	9.64	9.64	9.64	9.64	9.64	9.64	9.64	9.63	9.63	9.64
EURO 3	0.84	1.07	1.07	1.07	1.07	1.07	1.07	1.07	1.07	1.07	1.07	1.07	1.07	1.07
EURO 4	0.62	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
EURO 5	0.58	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84
EURO 6	0.58	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84
Gradient [%]: - 4														
v [km/h]	**0**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**	**110**	**120**	**130**
standard	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h
Pre EURO	6.46	16.91	16.91	16.91	16.91	16.91	16.91	16.91	16.91	16.91	16.91	17.15	18.18	19.77
EURO 1	4.29	11.22	11.22	11.22	11.22	11.22	11.22	11.22	11.22	11.22	11.22	11.38	12.06	13.11
EURO 2	2.18	9.64	9.64	9.64	9.64	9.64	9.64	9.64	9.64	9.64	9.64	9.77	10.36	11.26
EURO 3	0.84	1.07	1.07	1.07	1.07	1.07	1.07	1.07	1.07	1.07	1.07	1.55	6.85	2.43
EURO 4	0.62	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	1.29	1.73	2.03
EURO 5	0.58	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	1.21	1.35	1.90
EURO 6	0.58	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	1.21	1.35	1.90
Gradient [%]: - 2														
v [km/h]	**0**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**	**110**	**120**	**130**
standard	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h
Pre EURO	6.46	16.91	17.06	17.34	17.41	17.30	17.49	17.80	18.15	18.43	20.31	24.44	20.44	15.17
EURO 1	4.29	11.22	11.32	11.50	11.55	11.48	11.60	11.81	12.04	12.22	13.48	16.22	13.56	10.06
EURO 2	2.18	9.64	9.72	9.88	9.92	9.86	9.97	10.14	10.34	10.50	11.58	13.93	11.65	8.65
EURO 3	0.84	1.07	1.35	2.03	2.25	1.93	2.54	3.98	6.52	7.98	2.03	1.78	1.80	1.82
EURO 4	0.62	0.90	1.13	1.70	1.88	1.61	2.12	3.33	5.45	6.67	1.70	1.49	1.50	1.52
EURO 5	0.58	0.84	1.06	1.59	1.76	1.51	1.99	3.11	5.09	6.23	1.59	1.39	1.41	1.42
EURO 6	0.58	0.84	1.06	1.59	1.76	1.51	1.99	3.11	5.09	6.23	1.59	1.39	1.41	1.42

Gradient [%]: 2														
v [km/h]	**0**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**	**110**	**120**	**130**
standard	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h
Pre EURO	6.46	17.91	18.34	19.04	21.72	24.07	23.15	18.55	15.16	12.59	13.30	14.95	16.71	18.60
EURO 1	4.29	11.88	12.17	12.63	14.41	15.96	15.36	12.31	10.05	8.35	8.83	9.91	11.08	12.34
EURO 2	2.18	10.21	10.45	10.85	12.38	13.71	13.19	10.57	8.64	7.18	7.58	8.52	9.52	10.60
EURO 3	0.84	4.68	8.55	3.12	1.77	1.78	1.79	1.81	1.82	1.83	2.15	2.61	3.15	3.77
EURO 4	0.62	3.91	7.14	2.60	1.48	1.49	1.50	1.51	1.52	1.53	1.80	2.18	2.63	3.15
EURO 5	0.58	3.66	6.67	2.43	1.38	1.39	1.40	1.41	1.42	1.43	1.68	2.04	2.46	2.94
EURO 6	0.58	3.66	6.67	2.43	1.38	1.39	1.40	1.41	1.42	1.43	1.68	2.04	2.46	2.94
Gradient [%]: 4														
v [km/h]	**0**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**	**110**	**120**	**130**
standard	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h
Pre EURO	6.46	18.16	18.88	23.31	23.33	18.84	15.17	12.46	13.35	14.86	16.52	18.27	20.12	22.09
EURO 1	4.29	12.05	12.53	15.47	15.48	12.50	10.06	8.26	8.85	9.86	10.96	12.12	13.35	14.65
EURO 2	2.18	10.35	10.76	13.28	13.29	10.74	8.64	7.10	7.60	8.47	9.41	10.41	11.47	12.58
EURO 3	0.84	6.61	3.29	1.77	1.79	1.81	1.82	1.83	2.16	2.59	3.09	3.66	4.30	5.03
EURO 4	0.62	5.52	2.75	1.48	1.50	1.51	1.52	1.53	1.80	2.16	2.58	3.06	3.59	4.20
EURO 5	0.58	5.16	2.57	1.39	1.40	1.41	1.42	1.43	1.69	2.02	2.41	2.86	3.36	3.92
EURO 6	0.58	5.16	2.57	1.39	1.40	1.41	1.42	1.43	1.69	2.02	2.41	2.86	3.36	3.92
Gradient [%]: 6														
v [km/h]	**0**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**	**110**	**120**	**130**
standard	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h
Pre EURO	6.46	18.37	22.49	22.53	16.99	13.82	12.69	14.34	16.00	17.68	19.47	21.33	23.29	25.34
EURO 1	4.29	12.18	14.92	14.94	11.27	9.17	8.42	9.51	10.62	11.73	12.92	14.15	15.45	16.81
EURO 2	2.18	10.47	12.81	12.84	9.68	7.88	7.23	8.17	9.12	10.07	11.09	12.16	13.27	14.44
EURO 3	0.84	8.87	1.77	1.79	1.81	1.82	1.99	2.44	2.93	3.46	4.07	4.74	5.49	6.33
EURO 4	0.62	7.41	1.48	1.50	1.51	1.52	1.66	2.04	2.45	2.89	3.40	3.96	4.59	5.29
EURO 5	0.58	6.93	1.38	1.40	1.41	1.42	1.55	1.90	2.29	2.70	3.18	3.70	4.29	4.94
EURO 6	0.58	6.93	1.38	1.40	1.41	1.42	1.55	1.90	2.29	2.70	3.18	3.70	4.29	4.94

4.4. PC DIESEL NO_x

Gradient [%]: 0														
v [km/h]	**0**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**	**110**	**120**	**130**
standard	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h
Pre EURO	9.45	13.45	18.33	22.38	25.11	26.84	30.02	37.09	46.19	57.88	73.14	91.10	113.97	143.38
EURO 1	9.31	13.25	18.06	22.04	24.74	26.44	29.58	36.54	45.51	57.02	72.06	89.75	112.28	141.26
EURO 2	9.73	15.73	21.44	26.17	29.37	31.39	35.11	43.38	54.02	67.69	85.54	106.54	133.29	167.69
EURO 3	6.11	13.45	20.39	26.65	31.12	33.29	36.53	42.09	50.88	60.39	71.63	84.07	103.24	132.75
EURO 4	5.78	9.81	13.74	17.06	19.34	20.79	23.49	29.60	37.62	49.17	65.32	85.27	108.11	133.37
EURO 5	4.35	7.39	10.34	12.85	14.56	15.66	17.69	22.29	28.33	37.02	49.19	64.21	81.41	100.44
EURO 6	1.92	3.25	4.56	5.66	6.42	6.90	7.80	9.82	12.49	16.32	21.68	28.30	35.88	44.26
Gradient [%]: - 6														
v [km/h]	**0**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**	**110**	**120**	**130**
standard	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h
Pre EURO	9.45	8.02	8.02	8.02	8.02	8.02	8.02	8.02	8.02	8.02	8.02	8.02	8.02	8.02
EURO 1	9.31	7.90	7.90	7.90	7.90	7.90	7.90	7.90	7.90	7.90	7.90	7.90	7.90	7.90
EURO 2	9.73	9.38	9.38	9.38	9.38	9.38	9.38	9.38	9.38	9.38	9.38	9.38	9.38	9.38
EURO 3	6.11	6.71	6.71	6.71	6.71	6.71	6.71	6.71	6.71	6.71	6.71	6.71	6.71	6.71
EURO 4	5.78	5.58	5.58	5.58	5.58	5.58	5.58	5.58	5.58	5.58	5.58	5.58	5.58	5.58
EURO 5	4.35	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.21	4.20	4.20	4.20
EURO 6	1.92	1.85	1.85	1.85	1.85	1.85	1.85	1.85	1.85	1.85	1.85	1.85	1.85	1.85
Gradient [%]: - 4														
v [km/h]	**0**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**	**110**	**120**	**130**
standard	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h
Pre EURO	9.45	8.02	8.02	8.02	8.02	8.02	8.02	8.02	8.02	8.02	8.02	9.75	21.59	31.89
EURO 1	9.31	7.90	7.90	7.90	7.90	7.90	7.90	7.90	7.90	7.90	7.90	9.60	21.27	31.42
EURO 2	9.73	9.38	9.38	9.38	9.73	9.38	9.38	9.38	9.38	9.38	9.38	11.40	25.25	37.30
EURO 3	6.11	6.71	6.71	6.71	6.71	6.71	6.71	6.71	6.71	6.71	6.71	8.72	25.40	37.80
EURO 4	5.78	5.58	5.58	5.58	5.58	5.58	5.58	5.58	5.58	5.58	5.58	6.91	16.41	25.10
EURO 5	4.35	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.21	5.20	12.36	18.90
EURO 6	1.92	1.85	1.85	1.85	1.85	1.85	1.85	1.85	1.85	1.85	1.85	2.29	5.45	8.33
Gradient [%]: - 2														
v [km/h]	**0**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**	**110**	**120**	**130**
standard	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h
Pre EURO	9.45	8.02	9.07	11.28	11.92	10.97	12.71	16.15	21.02	25.88	33.30	44.69	60.91	81.43
EURO 1	9.31	7.90	8.94	11.11	11.75	10.81	12.52	15.92	20.71	25.50	32.81	44.03	60.01	80.23
EURO 2	9.73	9.38	10.61	13.19	13.94	12.83	14.87	18.89	24.58	30.27	38.95	52.26	71.24	95.24
EURO 3	6.11	6.71	7.92	10.61	11.43	10.23	12.46	17.20	24.50	32.15	38.74	49.44	62.68	77.46
EURO 4	5.78	5.58	6.39	8.10	8.60	7.86	9.22	11.97	15.94	19.98	26.31	36.28	52.31	74.42
EURO 5	4.35	4.20	4.81	6.10	6.48	5.92	6.94	9.01	12.00	15.05	19.82	27.32	39.39	56.04
EURO 6	1.92	1.85	2.12	2.69	2.85	2.61	3.06	3.97	5.29	6.63	8.73	12.04	17.36	24.70

Gradient [%]: 2														
v [km/h]	**0**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**	**110**	**120**	**130**
standard	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h
Pre EURO	9.45	17.61	24.29	30.04	37.05	43.59	53.94	66.95	81.52	97.64	119.72	146.37	177.42	213.46
EURO 1	9.31	17.35	23.93	29.60	36.50	42.95	53.14	65.95	80.32	96.20	117.95	144.20	174.80	210.30
EURO 2	9.73	20.60	28.41	35.13	43.33	50.98	63.08	78.30	95.34	114.20	140.02	171.18	207.51	249.65
EURO 3	6.11	19.32	29.76	36.54	42.05	48.39	57.36	67.15	77.53	88.43	108.97	135.78	167.62	205.22
EURO 4	5.78	13.15	18.65	23.51	29.56	35.32	45.13	58.67	74.52	92.76	113.10	135.91	162.06	191.91
EURO 5	4.35	9.90	14.05	17.70	22.26	26.59	33.99	44.18	56.11	69.85	85.17	102.34	122.03	144.51
EURO 6	1.92	4.36	6.19	7.80	9.81	11.72	14.98	19.47	24.73	30.79	37.53	45.11	53.78	63.69
Gradient [%]: 4														
v [km/h]	**0**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**	**110**	**120**	**130**
standard	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h
Pre EURO	9.45	21.17	29.66	41.45	53.54	65.94	81.46	98.67	120.37	144.99	174.02	207.06	244.63	287.30
EURO 1	9.31	20.86	29.22	40.84	52.75	64.96	80.25	97.21	118.59	142.85	171.44	203.99	241.01	283.04
EURO 2	9.73	24.76	34.69	48.48	62.62	77.12	95.27	115.40	140.78	169.57	203.52	242.16	286.11	336.01
EURO 3	6.11	24.74	36.28	46.33	57.05	66.41	77.48	89.11	109.62	134.38	164.10	198.50	238.25	284.10
EURO 4	5.78	16.06	23.18	33.42	44.74	57.60	74.45	93.95	113.66	134.74	159.21	186.64	217.39	251.81
EURO 5	4.35	12.10	17.46	25.17	33.69	43.37	56.06	70.75	85.59	101.46	119.89	140.55	163.70	189.62
EURO 6	1.92	5.33	7.69	11.09	14.85	19.12	24.71	31.18	37.72	44.72	52.84	61.94	72.15	83.57
Gradient [%]: 6														
v [km/h]	**0**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**	**110**	**120**	**130**
standard	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h
Pre EURO	9.45	24.78	39.15	55.40	72.92	89.18	110.39	136.31	164.72	195.62	231.07	270.64	314.82	364.19
EURO 1	9.31	24.41	38.57	54.58	71.84	87.86	108.75	134.30	162.28	192.73	227.65	266.63	310.16	358.80
EURO 2	9.73	28.98	45.79	64.80	85.28	104.30	129.10	159.42	192.65	228.79	270.25	316.52	368.20	425.94
EURO 3	6.11	30.57	44.10	58.49	71.47	82.78	99.70	125.60	154.52	186.53	223.83	266.11	314.03	368.32
EURO 4	5.78	19.06	31.40	46.63	65.08	83.10	105.00	127.35	151.41	177.19	206.34	238.42	273.79	312.80
EURO 5	4.35	14.35	23.64	35.11	49.01	62.58	79.07	95.90	114.02	133.43	155.38	179.54	206.17	235.55
EURO 6	1.92	6.33	10.42	15.47	21.60	27.58	34.85	42.26	50.25	58.81	68.48	79.13	90.86	103.81

4.5. PC DIESEL PM

Gradient [%]: 0														
v [km/h]	**0**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**	**110**	**120**	**130**
standard	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h
Pre EURO	0.60	1.20	1.94	2.63	3.14	3.48	4.04	4.90	6.00	7.25	8.77	10.48	12.50	14.89
EURO 1	0.70	1.40	2.25	3.06	3.65	4.04	4.69	5.70	6.98	8.42	10.19	12.17	14.52	17.30
EURO 2	0.66	1.07	1.72	2.33	2.78	3.08	3.58	4.35	5.32	6.43	7.77	9.29	11.07	13.19
EURO 3	0.32	0.57	0.92	1.26	1.51	1.67	1.93	2.30	2.75	3.36	4.15	5.06	6.06	7.14
EURO 4	0.25	0.56	0.81	1.01	1.16	1.25	1.41	1.72	2.12	2.66	3.38	4.23	5.05	5.74
EURO 5	0.02	0.06	0.08	0.10	0.11	0.12	0.14	0.17	0.21	0.26	0.34	0.42	0.50	0.57
EURO 6	0.02	0.05	0.07	0.09	0.10	0.11	0.12	0.15	0.18	0.23	0.29	0.36	0.43	0.49
Gradient [%]: - 6														
v [km/h]	**0**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**	**110**	**120**	**130**
standard	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h
Pre EURO	0.60	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54
EURO 1	0.70	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63
EURO 2	0.66	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.48
EURO 3	0.32	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26
EURO 4	0.25	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31
EURO 5	0.02	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
EURO 6	0.02	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
Gradient [%]: - 4														
v [km/h]	**0**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**	**110**	**120**	**130**
standard	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h
Pre EURO	0.60	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.73	2.49	4.27
EURO 1	0.70	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.85	2.89	4.96
EURO 2	0.66	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.65	2.21	3.78
EURO 3	0.32	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.35	1.19	2.03
EURO 4	0.25	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.39	0.97	1.49
EURO 5	0.02	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.04	0.10	0.15
EURO 6	0.02	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.08	0.13
Gradient [%]: - 2														
v [km/h]	**0**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**	**110**	**120**	**130**
standard	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h
Pre EURO	0.60	0.54	0.66	0.92	1.00	0.88	1.10	1.60	2.39	3.29	4.44	5.82	7.56	9.57
EURO 1	0.70	0.63	0.76	1.07	1.16	1.02	1.28	1.85	2.78	3.82	5.16	6.77	8.78	11.12
EURO 2	0.66	0.48	0.58	0.81	0.89	0.78	0.98	1.41	2.12	2.92	3.94	5.16	6.70	8.48
EURO 3	0.32	0.26	0.31	0.43	0.47	0.42	0.52	0.76	1.14	1.58	2.11	2.68	3.52	4.57
EURO 4	0.25	0.31	0.36	0.46	0.49	0.45	0.53	0.70	0.94	1.20	1.56	2.05	2.80	3.77
EURO 5	0.02	0.03	0.04	0.05	0.05	0.04	0.05	0.07	0.09	0.12	0.16	0.20	0.28	0.37
EURO 6	0.02	0.03	0.03	0.04	0.04	0.04	0.05	0.06	0.08	0.10	0.13	0.17	0.24	0.32

Gradient [%]: 2														
v [km/h]	**0**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**	**110**	**120**	**130**
standard	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h
Pre EURO	0.60	1.82	2.98	4.04	4.90	5.69	6.85	8.16	9.58	11.09	12.97	15.12	17.51	20.16
EURO 1	0.70	2.12	3.47	4.69	5.69	6.61	7.96	9.48	11.13	12.88	15.08	17.57	20.35	23.43
EURO 2	0.66	1.61	2.65	3.58	4.34	5.04	6.07	7.23	8.49	9.83	11.50	13.40	15.52	17.87
EURO 3	0.32	0.87	1.43	1.94	2.30	2.63	3.15	3.83	4.58	5.39	6.28	7.25	8.32	9.49
EURO 4	0.25	0.77	1.11	1.41	1.72	2.00	2.47	3.08	3.77	4.54	5.19	5.81	6.48	7.19
EURO 5	0.02	0.08	0.11	0.14	0.17	0.20	0.25	0.31	0.38	0.45	0.52	0.58	0.64	0.71
EURO 6	0.02	0.07	0.09	0.12	0.15	0.17	0.21	0.26	0.32	0.39	0.44	0.50	0.55	0.61
Gradient [%]: 4														
v [km/h]	**0**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**	**110**	**120**	**130**
standard	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h
Pre EURO	0.60	2.42	3.99	5.43	6.81	8.06	9.57	11.18	13.03	15.01	17.25	19.70	22.37	25.29
EURO 1	0.70	2.81	4.64	6.31	7.91	9.37	11.12	12.99	15.14	17.44	20.05	22.89	25.99	29.38
EURO 2	0.66	2.14	3.54	4.82	6.03	7.14	8.48	9.91	11.55	13.31	15.29	17.46	19.83	22.41
EURO 3	0.32	1.16	1.92	2.52	3.13	3.78	4.58	5.44	6.31	7.20	8.21	9.29	10.47	11.74
EURO 4	0.25	0.95	1.39	1.91	2.45	3.04	3.77	4.59	5.20	5.78	6.41	7.06	7.76	8.50
EURO 5	0.02	0.09	0.14	0.19	0.24	0.30	0.37	0.46	0.52	0.57	0.64	0.70	0.77	0.84
EURO 6	0.02	0.08	0.12	0.16	0.21	0.26	0.32	0.39	0.44	0.49	0.55	0.60	0.66	0.72
Gradient [%]: 6														
v [km/h]	**0**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**	**110**	**120**	**130**
standard	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h
Pre EURO	0.60	3.08	5.15	7.00	8.75	10.30	12.20	14.32	16.55	18.86	21.42	24.16	27.11	30.30
EURO 1	0.70	3.58	5.99	8.13	10.16	11.97	14.17	16.64	19.23	21.92	24.89	28.07	31.50	35.20
EURO 2	0.66	2.73	4.57	6.20	7.75	9.13	10.81	12.69	14.67	16.72	18.98	21.41	24.03	26.85
EURO 3	0.32	1.48	2.40	3.23	4.14	4.97	5.93	6.89	7.89	8.92	10.05	11.25	12.53	13.91
EURO 4	0.25	1.14	1.81	2.54	3.37	4.14	4.96	5.58	6.21	6.84	7.52	8.21	8.95	9.71
EURO 5	0.02	0.11	0.18	0.25	0.33	0.41	0.49	0.55	0.62	0.68	0.75	0.82	0.89	0.96
EURO 6	0.02	0.10	0.15	0.22	0.29	0.35	0.42	0.48	0.53	0.58	0.64	0.70	0.76	0.83

4.6. LDV GASOLINE CO

Gradient [%]: 0														
v [km/h]	**0**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**	**110**	**120**	**130**
standard	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h
Pre EURO	49.50	219.33	334.60	360.53	216.58	157.63	165.79	327.24	603.15	1,039.80	1,728.39	2,441.42	3,364.04	4,532.09
EURO 1	0.63	108.69	165.81	178.66	107.32	78.11	82.16	162.16	298.89	515.26	856.49	1,209.82	1,667.02	2,245.83
EURO 2	0.43	64.72	98.74	106.39	63.91	46.52	48.93	96.57	177.99	306.85	510.05	720.47	992.73	1,337.42
EURO 3	0.24	58.74	89.61	96.56	58.00	42.22	44.40	87.64	161.54	278.48	462.90	653.86	900.96	1,213.79
EURO 4	0.77	50.49	77.02	82.99	49.85	36.28	38.16	75.33	138.84	239.35	397.85	561.98	774.36	1,043.23
EURO 5	0.77	40.39	61.62	66.39	39.88	29.03	30.53	60.26	111.07	191.48	318.28	449.59	619.49	834.58
EURO 6	0.77	40.39	61.62	66.39	39.88	29.03	30.53	60.26	111.07	191.48	318.28	449.59	619.49	834.58
Gradient [%]: - 6														
v [km/h]	**0**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**	**110**	**120**	**130**
standard	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h
Pre EURO	49.50	92.81	92.81	92.81	92.81	92.81	92.81	92.81	92.81	92.81	92.81	92.81	168,57	260.79
EURO 1	0.63	45.99	45.99	45.99	45.99	45.99	45.99	45.99	45.99	45.99	45.99	45.99	83,53	129.23
EURO 2	0.43	27.39	27.39	27.39	27.39	27.39	27.39	27.39	27.39	27.39	27.39	27.39	49,75	76.96
EURO 3	0.24	24.86	24.86	24.86	24.86	24.86	24.86	24.86	24.86	24.86	24.86	24.86	45,15	69.84
EURO 4	0.77	21.36	21.36	21.36	21.36	21.36	21.36	21.36	21.36	21.36	21.36	21.36	38,80	60.03
EURO 5	0.77	17.09	17.09	17.09	17.09	17.09	17.09	17.09	17.09	17.09	17.09	17.09	31,04	48.02
EURO 6	0.77	17.09	17.09	17.09	17.09	17.09	17.09	17.09	17.09	17.09	17.09	17.09	31,04	48.02
Gradient [%]: - 4														
v [km/h]	**0**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**	**110**	**120**	**130**
standard	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h
Pre EURO	49.50	92.81	92.81	92.81	92.81	92.81	92.81	92.81	92.81	229.30	323.89	370.08	416.27	1000.25
EURO 1	0.63	45.99	45.99	45.99	45.99	45.99	45.99	45.99	45.99	113.63	160.50	183.39	206.28	495.67
EURO 2	0.43	27.39	27.39	27.39	27.39	27.39	27.39	27.39	27.39	67.67	95.58	109.21	122.84	295.18
EURO 3	0.24	24.86	24.86	24.86	24.86	24.86	24.86	24.86	24.86	61.41	86.75	99.12	111.49	267.89
EURO 4	0.77	21.36	21.36	21.36	21.36	21.36	21.36	21.36	21.36	52.78	74.56	85.19	95.82	230.25
EURO 5	0.77	17.09	17.09	17.09	17.09	17.09	17.09	17.09	17.09	42.22	59.65	68.15	76.66	184.20
EURO 6	0.77	17.09	17.09	17.09	17.09	17.09	17.09	17.09	17.09	42.22	59.65	68.15	76.66	184.20
Gradient [%]: - 2														
v [km/h]	**0**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**	**110**	**120**	**130**
standard	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h
Pre EURO	49.50	104.38	152.08	208.53	259.31	281.53	356.86	304.14	149.62	222.62	504.73	1,025.92	1,806.61	2,644.33
EURO 1	0.63	51.73	75.36	103.34	128.50	139.51	176.84	150.71	74.14	110.32	250.11	508.38	895.25	1,310.37
EURO 2	0.43	30.80	44.88	61.54	76.52	83.08	105.31	89.75	44.15	65.70	148.95	302.75	533.13	780.34
EURO 3	0.24	27.96	40.73	55.85	69.45	75.40	95.57	81.46	40.07	59.62	135.18	274.76	483.85	708.20
EURO 4	0.77	24.03	35.01	48.00	59.69	64.80	82.14	70.01	34.44	51.24	116.18	236.15	415.86	608.69
EURO 5	0.77	19.22	28.01	38.40	47.75	51.84	65.72	56.01	27.55	41.00	92.95	188.92	332.69	486.95
EURO 6	0.77	19.22	28.01	38.40	47.75	51.84	65.72	56.01	27.55	41.00	92.95	188.92	332.69	486.95

Gradient [%]: 2														
v [km/h]	**0**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**	**110**	**120**	**130**
standard	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h
Pre EURO	49.50	307.59	296.49	145.94	199.39	337.41	596.34	1,022.41	1,643.55	2,223.85	3,012.52	4,009.08	5,248.59	6,767.15
EURO 1	0.63	152.43	146.92	72.32	98.81	167.20	295.51	506.65	814.45	1,102.01	1,492.82	1,986.66	2,600.89	3,353.40
EURO 2	0.43	90.77	87.50	43.07	58.84	99.57	175.98	301.72	485.02	656.26	889.00	1,183.08	1,548.87	1,997.00
EURO 3	0.24	82.38	79.41	39.08	53.40	90.37	159.71	273.82	440.18	595.59	806.81	1,073.71	1,405.68	1,812.38
EURO 4	0.77	70.80	68.25	33.59	45.90	77.67	137.27	235.35	378.32	511.90	693.44	922.84	1,208.16	1,557.71
EURO 5	0.77	56.64	54.60	26.87	36.72	62.13	109.82	188.28	302.66	409.52	554.75	738.27	966.53	1,246.17
EURO 6	0.77	56.64	54.60	26.87	36.72	62.13	109.82	188.28	302.66	409.52	554.75	738.27	966.53	1,246.17
Gradient [%]: 4														
v [km/h]	**0**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**	**110**	**120**	**130**
standard	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h
Pre EURO	49.50	389.03	154.89	241.71	488.01	807.02	1,353.62	1,975.31	2,656.38	3,475.28	4,539.74	5,843.70	7,422.87	7,782.07
EURO 1	0.63	192.78	76.75	119.78	241.83	399.91	670.77	978.84	1,316.34	1,722.14	2,249.63	2,895.79	3,678.33	3,856.33
EURO 2	0.43	114.80	45.71	71.33	144.01	238.15	399.45	582.92	783.90	1,025.56	1,339.68	1,724.48	2,190.50	,2,296.50
EURO 3	0.24	104.19	41.48	64.74	130.70	216.14	362.53	529.03	711.43	930.75	1,215.84	1,565.06	1,988.00	2,084.20
EURO 4	0.77	89.55	35.65	55.64	112.33	185.77	311.59	454.69	611.46	799.97	1,044.99	1,345.14	1,708.65	1,791.33
EURO 5	0.77	71.64	28.52	44.51	89.87	148.61	249.27	363.75	489.17	639.97	835.99	1,076.12	1,366.92	1,433.07
EURO 6	0.77	71.64	28.52	44.51	89.87	148.61	249.27	363.75	489.17	639.97	835.99	1,076.12	1,366.92	1,433.07
Gradient [%]: 6														
v [km/h]	**0**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**	**110**	**120**	**130**
standard	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h
Pre EURO	49.50	296.11	188.41	475.61	932.63	1,518.45	2,150.24	2,915.29	3,836.51	4,919.78	6,284.41	7,919.37	8,491.82	9,195.33
EURO 1	0.63	146.73	93.36	235.69	462.16	752.45	1,065.53	1,444.64	1,901.14	2,437.95	3,114.18	3,924.37	4,208.04	4,556.66
EURO 2	0.43	87.38	55.60	140.35	275.22	448.10	634.54	860.31	1,132.16	1,451.83	1,854.54	2,337.01	2,505.95	2,713.56
EURO 3	0.24	79.30	50.46	127.38	249.78	406.67	575.88	780.78	1,027.50	1,317.62	1,683.10	2,120.97	2,274.28	2,462.70
EURO 4	0.77	68.16	43.37	109.48	214.68	349.53	494.96	671.06	883.11	1,132.47	1,446.59	1,822.94	1,954.71	2,116.65
EURO 5	0.77	54.53	34.69	87.58	171.74	279.62	395.97	536.85	706.49	905.98	1,157.27	1,458.35	1,563.77	1,693.32
EURO 6	0.77	54.53	34.69	87.58	171.74	279.62	395.97	536.85	706.49	905.98	1,157.27	1,458.35	1,563.77	1,693.32

4.7. LDV GASOLINE NO_X

Gradient [%]: 0														
v [km/h]	**0**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**	**110**	**120**	**130**
standard	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h
Pre EURO	11.73	33.83	67.80	85.68	54.82	41.50	41.27	66.51	102.14	149.67	211.54	258.04	310.31	368.36
EURO 1	3.60	21.72	43.52	55.00	35.19	26.64	26.49	42.69	65.56	96.07	135.78	165.63	199.18	236.44
EURO 2	2.86	14.02	28.09	35.50	22.72	17.20	17.10	27.56	42.32	62.01	87.65	106.92	128.57	152.62
EURO 3	0.68	6.36	12.75	16.11	10.31	7.81	7.76	12.51	19.21	28.15	39.79	48.53	58.36	69.28
EURO 4	0.54	3.32	6.66	8.42	5.39	4.08	4.05	6.53	10.03	14.70	20.78	25.35	30.48	36.19
EURO 5	0.50	2.99	5.99	7.58	4.85	3.67	3.65	5.88	9.03	13.23	18.70	22.81	27.44	32.57
EURO 6	0.50	2.99	5.99	7.58	4.85	3.67	3.65	5.88	9.03	13.23	18.70	22.81	27.44	32.57
Gradient [%]: - 6														
v [km/h]	**0**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**	**110**	**120**	**130**
standard	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h
Pre EURO	11.73	8.21	8.21	8.22	8.22	8.22	8.21	8.21	8.21	8.22	8.22	8.22	44.01	44.99
EURO 1	3.60	5.27	5.27	5.27	5.27	5.27	5.27	5.27	5.27	5.27	5.27	5.27	28.25	28.88
EURO 2	2.86	3.40	3.40	3.40	3.40	3.40	3.40	3.40	3.40	3.40	3.40	3.40	18.24	18.64
EURO 3	0.68	1.55	1.55	1.55	1.55	1.55	1.55	1.54	1.54	1.55	1.55	1.55	8.28	8.46
EURO 4	0.54	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	4.32	4.42
EURO 5	0.50	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	3.89	3.98
EURO 6	0.47	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	3.89	3.98
Gradient [%]: - 4														
v [km/h]	**0**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**	**110**	**120**	**130**
standard	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h
Pre EURO	11.73	8.21	8.21	8.22	8.22	8.22	8.21	8.21	8.21	15.08	23.50	37.22	78.74	145.65
EURO 1	3.60	5.27	5.27	5.27	3.60	5.27	5.27	5.27	5.27	6.85	15.20	23.89	50.54	93.49
EURO 2	2.86	3.40	3.40	3.40	2.86	3.40	3.40	3.40	3.40	3.85	6.90	15.42	32.62	60.35
EURO 3	0.68	1.55	1.55	1.55	0.68	1.55	1.55	1.54	1.54	3.22	3.60	7.00	14.81	27.39
EURO 4	0.54	0.81	0.81	0.81	0.54	0.81	0.81	0.81	0.81	1.85	3.28	3.66	7.74	14.31
EURO 5	0.50	0.73	0.73	0.73	0.50	0.73	0.73	0.73	0.73	1.75	2.25	3.29	6.96	12.88
EURO 6	0.47	0.73	0.73	0.73	0.47	0.73	0.73	0.73	0.73	1.75	2.25	3.29	6.96	12.88
Gradient [%]: - 2														
v [km/h]	**0**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**	**110**	**120**	**130**
standard	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h
Pre EURO	11.73	9.97	18.52	31.13	44.57	51.03	75.38	73.82	39.65	50.76	90.14	148.27	216.99	270.17
EURO 1	3.60	6.40	11.89	19.98	28.61	32.75	48.38	47.38	25.45	32.58	57.86	95.17	139.28	173.42
EURO 2	2.86	4.13	7.67	12.90	18.47	21.14	31.23	30.59	16.43	21.03	37.35	61.43	89.91	111.94
EURO 3	0.68	1.87	3.48	5.86	8.38	9.60	14.18	13.88	7.46	9.55	16.95	27.89	40.81	50.81
EURO 4	0.54	0.98	1.82	3.06	4.38	5.01	7.41	7.25	3.90	4.99	8.86	14.57	21.32	26.54
EURO 5	0.50	0.88	1.64	2.75	3.94	4.51	6.66	6.53	3.51	4.49	7.97	13.11	19.18	23.89
EURO 6	0.47	0.88	1.64	2.75	3.94	4.51	6.66	6.53	3.51	4.49	7.97	13.11	19.18	23.89

Gradient [%]: 2														
v [km/h]	**0**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**	**110**	**120**	**130**
standard	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h
Pre EURO	11.73	59.03	72.19	38.79	46.98	67.95	101.33	147.91	205.50	244.55	291.22	343.26	400.81	463.92
EURO 1	3.60	37.89	46.34	24.90	30.15	43.62	65.04	94.94	131.90	156.97	186.92	220.33	257.27	297.78
EURO 2	2.86	24.46	29.91	16.07	19.47	28.15	41.98	61.28	85.14	101.32	120.66	142.22	166.07	192.22
EURO 3	0.68	11.10	13.58	7.30	8.84	12.78	19.06	27.82	38.65	45.99	54.77	64.56	75.38	87.25
EURO 4	0.54	5.80	7.09	3.81	4.62	6.68	9.95	14.53	20.19	24.02	28.61	33.72	39.37	45.57
EURO 5	0.50	5.22	6.38	3.43	4.15	6.01	8.96	13.08	18.17	21.62	25.75	30.35	35.44	41.02
EURO 6	0.47	5.22	6.38	3.43	4.15	6.01	8.96	13.08	18.17	21.62	25.75	30.35	35.44	41.02
Gradient [%]: 4														
v [km/h]	**0**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**	**110**	**120**	**130**
standard	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h
Pre EURO	11.73	86.89	40.87	53.77	88.03	125.29	180.10	228.43	270.88	316.17	368.71	426.36	489.28	503.35
EURO 1	3.60	55.77	26.23	34.52	56.51	80.42	115.60	146.62	173.87	202.94	236.67	273.67	314.05	323.09
EURO 2	2.86	36.00	16.93	22.28	36.47	51.91	74.62	94.65	112.23	131.00	152.77	176.66	202.72	208.56
EURO 3	0.68	16.34	7.69	10.11	16.56	23.56	33.87	42.96	50.95	59.46	69.35	80.19	92.02	94.67
EURO 4	0.54	8.54	4.01	5.28	8.65	12.31	17.69	22.44	26.61	31.06	36.22	41.88	48.06	49.45
EURO 5	0.50	7.68	3.61	4.75	7.78	11.08	15.92	20.20	23.95	27.95	32.60	37.70	43.26	44.50
EURO 6	0.47	7.68	3.61	4.75	7.78	11.08	15.92	20.20	23.95	27.95	32.60	37.70	43.26	44.50
Gradient [%]: 6														
v [km/h]	**0**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**	**110**	**120**	**130**
standard	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h
Pre EURO	11.73	72.11	45.15	86.46	138.67	195.22	239.86	285.77	334.68	386.17	444.58	507.85	536.24	575.67
EURO 1	3.60	46.28	28.98	55.49	89.01	125.31	153.96	183.43	214.82	247.87	285.37	325.97	344.20	369.51
EURO 2	2.86	29.88	18.71	35.82	57.46	80.89	99.38	118.40	138.67	160.00	184.20	210.42	222.18	238.52
EURO 3	0.68	13.56	8.49	16.26	26.08	36.72	45.11	53.75	62.95	72.63	83.62	95.52	100.86	108.27
EURO 4	0.54	7.08	4.44	8.49	13.62	19.18	23.56	28.07	32.88	37.94	43.67	49.89	52.68	56.55
EURO 5	0.50	6.38	3.99	7.64	12.26	17.26	21.21	25.27	29.59	34.14	39.31	44.90	47.41	50.90
EURO 6	0.47	6.38	3.99	7.64	12.26	17.26	21.21	25.27	29.59	34.14	39.31	44.90	47.41	50.90

4.8. LDV DIESEL CO

Gradient [%]: 0														
v [km/h]	**0**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**	**110**	**120**	**130**
standard	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h
Pre EURO	9.07	62.94	74.44	76.40	61.60	53.86	51.18	57.39	63.63	69.74	75.51	77.99	80.38	82.66
EURO 1	6.02	22.90	27.09	27.80	22.41	19.60	18.62	20.88	23.15	25.38	27.48	28.38	29.25	30.08
EURO 2	3.06	10.48	12.39	12.72	10.25	8.97	8.52	9.55	10.59	11.61	12.57	12.98	13.38	13.76
EURO 3	1.18	6.23	7.37	7.56	6.09	5.33	5.06	5.68	6.30	6.90	7.47	7.72	7.95	8.18
EURO 4	0.88	5.39	6.38	6.54	5.28	4.61	4.38	4.92	5.45	5.97	6.47	6.68	6.88	7.08
EURO 5	0.82	3.23	3.83	3.93	3.17	2.77	2.63	2.95	3.27	3.58	3.88	4.01	4.13	4.25
EURO 6	0.82	3.23	3.83	3.93	3.17	2.77	2.63	2.95	3.27	3.58	3.88	4.01	4.13	4.25
Gradient [%]: - 6														
v [km/h]	**0**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**	**110**	**120**	**130**
standard	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h
Pre EURO	9.07	44.72	44.72	44.72	44.72	44.72	44.72	44.72	44.72	44.72	44.72	44.72	67.42	55.41
EURO 1	6.02	16.27	16.27	16.27	16.27	16.27	16.27	16.27	16.27	16.27	16.27	16.27	24.53	20.16
EURO 2	3.06	7.44	7.44	7.44	7.44	7.44	7.44	7.44	7.44	7.44	7.44	7.44	11.22	9.22
EURO 3	1.18	4.43	4.43	4.43	4.42	4.43	4.43	4.42	4.42	4.43	4.43	4.43	6.67	5.48
EURO 4	0.88	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.83	5.78	4.75
EURO 5	0.82	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	3.47	2.85
EURO 6	0.82	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	3.47	2.85
Gradient [%]: - 4														
v [km/h]	**0**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**	**110**	**120**	**130**
standard	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h
Pre EURO	9.07	44.72	44.72	44.72	44.72	44.72	44.72	44.72	44.72	64.06	70.92	69.77	59.77	69.29
EURO 1	6.02	16.27	16.27	16.27	16.27	16.27	16.27	16.27	16.27	23.31	26.00	25.50	21.75	25.21
EURO 2	3.06	7.44	7.44	7.44	7.44	7.44	7.44	7.44	7.44	10.66	11.90	11.70	9.95	11.53
EURO 3	1.18	4.43	4.43	4.43	4.42	4.43	4.43	4.42	4.42	6.34	7.10	7.00	5.91	6.86
EURO 4	0.88	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.83	5.49	6.10	6.00	5.12	5.94
EURO 5	0.82	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	3.29	3.70	3.60	3.07	3.56
EURO 6	0.82	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	3.29	3.70	3.60	3.07	3.56
Gradient [%]: -2														
v [km/h]	**0**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**	**110**	**120**	**130**
standard	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h
Pre EURO	9.07	46.86	54.42	61.69	67.27	69.50	76.37	71.10	52.69	53.79	61.74	69.59	75.82	78.58
EURO 1	6.02	17.05	19.80	22.45	24.48	25.29	27.79	25.87	19.17	19.57	22.47	25.32	27.59	28.59
EURO 2	3.06	7.80	9.06	10.27	11.20	11.57	12.71	11.84	8.77	8.95	10.28	11.58	12.62	13.08
EURO 3	1.18	4.64	5.38	6.10	6.66	6.88	7.56	7.04	5.21	5.32	6.11	6.88	7.50	7.78
EURO 4	0.88	4.01	4.66	5.28	5.76	5.95	6.54	6.09	4.51	4.61	5.29	5.96	6.49	6.73
EURO 5	0.82	2.41	2.80	3.17	3.46	3.57	3.93	3.65	2.71	2.76	3.17	3.58	3.90	4.04
EURO 6	0.82	2.41	2.80	3.17	3.46	3.57	3.93	3.65	2.71	2.76	3.17	3.58	3.90	4.04

Gradient [%]: 2														
v [km/h]	**0**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**	**110**	**120**	**130**
standard	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h
Pre EURO	9.07	71.99	70.34	52.13	52.80	57.69	63.50	69.55	75.15	77.31	79.55	81.71	83.80	85.82
EURO 1	6.02	26.20	25.60	18.97	19.21	20.99	23.11	25.31	27.35	28.13	28.95	29.73	30.49	31.23
EURO 2	3.06	11.98	11.71	8.68	8.79	9.60	10.57	11.58	12.51	12.87	13.24	13.60	13.95	14.29
EURO 3	1.18	7.12	6.96	5.16	5.22	5.71	6.28	6.88	7.44	7.65	7.87	8.09	8.29	8.49
EURO 4	0.88	6.17	6.03	4.47	4.52	4.94	5.44	5.96	6.44	6.62	6.81	7.00	7.18	7.35
EURO 5	0.82	3.70	3.62	2.68	2.71	2.97	3.26	3.57	3.86	3.97	4.09	4.20	4.31	4.41
EURO 6	0.82	3.70	3.62	2.68	2.71	2.97	3.26	3.57	3.86	3.97	4.09	4.20	4.31	4.41
Gradient [%]: 4														
v [km/h]	**0**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**	**110**	**120**	**130**
standard	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h
Pre EURO	9.07	79.04	53.46	54.54	61.39	66.83	72.91	76.46	78.61	80.62	82.67	84.65	86.57	87.18
EURO 1	6.02	28.76	19.45	19.85	22.34	24.32	26.53	27.82	28.61	29.34	30.08	30.80	31.50	31.72
EURO 2	3.06	13.16	8.90	9.08	10.22	11.12	12.14	12.73	13.09	13.42	13.76	14.09	14.41	14.51
EURO 3	1.18	7.82	5.29	5.40	6.07	6.61	7.21	7.57	7.78	7.98	8.18	8.38	8.57	8.63
EURO 4	0.88	6.77	4.58	4.67	5.26	5.72	6.25	6.55	6.73	6.91	7.08	7.25	7.42	7.47
EURO 5	0.82	4.06	2.75	2.80	3.16	3.43	3.75	3.93	4.04	4.14	4.25	4.35	4.45	4.48
EURO 6	0.82	4.06	2.75	2.80	3.16	3.43	3.75	3.93	4.04	4.14	4.25	4.35	4.45	4.48
Gradient [%]: 6														
v [km/h]	**0**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**	**110**	**120**	**130**
standard	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h
Pre EURO	9.07	70.30	52.29	61.13	68.48	74.34	77.07	79.30	81.37	83.29	85.23	87.10	90.38	96.08
EURO 1	6.02	25.58	19.03	22.24	24.92	27.05	28.04	28.86	29.61	30.31	31.01	31.69	32.89	34.96
EURO 2	3.06	11.70	8.70	10.18	11.40	12.37	12.83	13.20	13.55	13.87	14.19	14.50	15.04	15.99
EURO 3	1.18	6.96	5.17	6.05	6.78	7.36	7.63	7.85	8.05	8.24	8.43	8.62	8.94	9.51
EURO 4	0.88	6.02	4.48	5.24	5.87	6.37	6.60	6.79	6.97	7.14	7.30	7.46	7.74	8.23
EURO 5	0.82	3.61	2.69	3.14	3.52	3.82	3.96	4.08	4.18	4.28	4.38	4.48	4.65	4.94
EURO 6	0.82	3.61	2.69	3.14	3.52	3.82	3.96	4.08	4.18	4.28	4.38	4.48	4.65	4.94

4.9. LDV DIESEL NO_X

Gradient [%]: 0														
v [km/h]	**0**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**	**110**	**120**	**130**
standard	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h
Pre EURO	13.63	25.17	30.77	34.63	36.41	37.56	44.22	61.83	83.57	109.30	146.07	203.86	277.78	370.37
EURO 1	13.42	22.66	27.70	31.18	32.78	33.82	39.82	55.67	75.25	98.41	131.52	183.56	250.12	333.48
EURO 2	14.03	20.82	25.45	28.65	30.12	31.07	36.58	51.14	69.13	90.41	120.83	168.64	229.78	306.36
EURO 3	8.81	15.65	19.13	21.54	22.64	23.36	27.50	38.45	51.97	67.97	90.83	126.77	172.74	230.31
EURO 4	8.33	12.45	15.22	17.13	18.01	18.58	21.88	30.58	41.34	54.06	72.25	100.84	137.40	183.20
EURO 5	6.27	9.45	11.55	13.00	13.66	14.10	16.60	23.21	31.37	41.02	54.83	76.52	104.26	139.01
EURO 6	2.77	3.85	4.70	5.29	5.56	5.74	6.76	9.45	12.77	16.70	22.32	31.15	42.45	56.60
Gradient [%]: - 6														
v [km/h]	**0**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**	**110**	**120**	**130**
standard	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h
Pre EURO	13.63	16.73	16.73	16.73	16.73	16.73	16.73	16.73	16.73	16.73	16.73	16.73	27.33	37.31
EURO 1	13.42	15.06	15.06	15.06	15.06	15.06	15.06	15.06	15.06	15.06	15.06	15.06	24.61	33.60
EURO 2	14.03	13.84	13.84	13.84	13.84	13.84	13.84	13.84	13.84	13.84	13.84	13.84	22.61	30.86
EURO 3	8.81	10.40	10.40	10.40	10.40	10.40	10.40	10.40	10.40	10.40	10.40	10.40	17.00	23.20
EURO 4	8.33	8.27	8.27	8.27	8.27	8.27	8.27	8.27	8.27	8.27	8.27	8.27	13.52	18.46
EURO 5	6.27	6.28	6.28	6.28	6.28	6.28	6.28	6.28	6.28	6.28	6.28	6.28	10.26	14.00
EURO 6	2.77	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	4.18	5.70
Gradient [%]: - 4														
v [km/h]	**0**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**	**110**	**120**	**130**
standard	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h
Pre EURO	13.63	16.73	16.73	16.73	16.73	16.73	16.73	16.73	16.73	25.71	35.00	41.13	69.61	107.23
EURO 1	13.42	15.06	15.06	15.06	15.06	15.06	15.06	15.06	15.06	23.15	31.51	37.03	62.68	96.55
EURO 2	14.03	13.84	13.84	13.84	13.84	13.84	13.84	13.84	13.84	21.27	28.95	34.02	57.58	88.70
EURO 3	8.81	10.40	10.40	10.40	10.40	10.40	10.40	10.40	10.40	15.99	21.76	25.58	43.29	66.68
EURO 4	8.33	8.27	8.27	8.27	8.27	8.27	8.27	8.27	8.27	12.72	17.31	20.34	34.43	53.04
EURO 5	6.27	6.28	6.28	6.28	6.28	6.28	6.28	6.28	6.28	9.65	13.14	15.44	26.13	40.25
EURO 6	2.77	2.56	2.56	2.56	2.56	2.56	2.56	2.56	2.56	3.93	5.35	6.28	10.64	16.39
Gradient [%]: - 2														
v [km/h]	**0**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**	**110**	**120**	**130**
standard	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h
Pre EURO	13.63	17.69	21.15	24.58	27.26	28.34	31.72	35.21	37.75	51.14	76.55	108.58	152.45	220.19
EURO 1	13.42	15.93	19.05	22.13	24.54	25.52	28.56	31.71	33.99	46.04	68.92	97.76	137.26	198.26
EURO 2	14.03	14.63	17.50	20.33	22.55	23.45	26.24	29.13	31.23	42.30	63.32	89.82	126.10	182.14
EURO 3	8.81	11.00	13.15	15.28	16.95	17.63	19.73	21.90	23.48	31.80	47.60	67.52	94.80	136.93
EURO 4	8.33	8.75	10.46	12.16	13.48	14.02	15.69	17.42	18.67	25.30	37.86	53.71	75.41	108.92
EURO 5	6.27	6.64	7.94	9.22	10.23	10.64	11.91	13.22	14.17	19.19	28.73	40.75	57.22	82.64
EURO 6	2.77	2.70	3.23	3.76	4.17	4.33	4.85	5.38	5.77	7.81	11.70	16.59	23.30	33.65

Gradient [%]: 2														
v [km/h]	**0**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**	**110**	**120**	**130**
standard	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h
Pre EURO	13.63	29.56	35.30	37.84	48.43	62.77	83.10	108.40	139.15	186.30	249.71	329.03	426.73	545.34
EURO 1	13.42	26.62	31.79	34.07	43.61	56.52	74.83	97.60	125.29	167.75	224.85	296.26	384.23	491.03
EURO 2	14.03	24.45	29.20	31.30	40.06	51.92	68.74	89.66	115.10	154.11	206.56	272.17	352.99	451.11
EURO 3	8.81	18.38	21.95	23.53	30.12	39.03	51.68	67.40	86.53	115.85	155.28	204.60	265.36	339.12
EURO 4	8.33	14.62	17.46	18.72	23.96	31.05	41.11	53.62	68.83	92.15	123.52	162.75	211.08	269.75
EURO 5	6.27	11.10	13.25	14.20	18.18	23.56	31.19	40.68	52.23	69.92	93.73	123.49	160.16	204.68
EURO 6	2.77	4.52	5.39	5.78	7.40	9.59	12.70	16.56	21.26	28.47	38.16	50.28	65.21	83.34
Gradient [%]: 4														
v [km/h]	**0**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**	**110**	**120**	**130**
standard	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h
Pre EURO	13.63	33.05	37.62	53.25	75.29	96.47	124.47	166.16	221.16	286.64	370.97	473.34	596.26	624.14
EURO 1	13.42	29.76	33.88	47.95	67.79	86.86	112.07	149.62	199.14	258.10	334.02	426.20	536.88	561.98
EURO 2	14.03	27.34	31.12	44.05	62.28	79.80	102.96	137.45	182.94	237.11	306.87	391.55	493.22	516.29
EURO 3	8.81	20.55	23.40	33.12	46.82	59.99	77.40	103.33	137.53	178.25	230.68	294.34	370.78	388.12
EURO 4	8.33	16.35	18.61	26.34	37.24	47.72	61.57	82.19	109.40	141.79	183.50	234.14	294.94	308.73
EURO 5	6.27	12.41	14.12	19.99	28.26	36.21	46.72	62.37	83.01	107.59	139.24	177.66	223.79	234.26
EURO 6	2.77	5.05	5.75	8.14	11.50	14.74	19.02	25.39	33.80	43.80	56.69	72.33	91.12	95.38
Gradient [%]: 6														
v [km/h]	**0**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**	**110**	**120**	**130**
standard	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h
Pre EURO	13.63	35.31	47.10	74.34	103.59	131.72	180.35	241.93	315.35	400.90	507.75	634.71	679.73	735.52
EURO 1	13.42	31.79	42.41	66.93	93.28	118.60	162.38	217.84	283.94	360.97	457.18	571.50	612.03	662.27
EURO 2	14.03	29.21	38.96	61.49	85.69	108.96	149.18	200.13	260.86	331.62	420.01	525.03	562.27	608.42
EURO 3	8.81	21.96	29.29	46.23	64.42	81.91	112.15	150.44	196.10	249.30	315.74	394.69	422.68	457.38
EURO 4	8.33	17.46	23.30	36.77	51.24	65.16	89.21	119.67	155.99	198.30	251.16	313.96	336.23	363.82
EURO 5	6.27	13.25	17.68	27.90	38.88	49.44	67.69	90.80	118.36	150.47	190.57	238.22	255.12	276.06
EURO 6	2.77	5.40	7.20	11.36	15.83	20.13	27.56	36.97	48.19	61.26	77.59	96.99	103.87	112.40

4.10. LDV DIESEL PM

Gradient [%]: 0														
v [km/h]	**0**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**	**110**	**120**	**130**
standard	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h
Pre EURO	2.58	1.72	2.83	3.90	4.89	5.64	6.90	8.75	10.85	13.15	16.26	19.80	23.77	28.18
EURO 1	3.00	2.00	3.29	4.53	5.69	6.56	8.02	10.17	12.61	15.28	18.89	23.01	27.62	32.74
EURO 2	2.85	1.25	2.06	2.84	3.56	4.11	5.03	6.37	7.90	9.57	11.84	14.42	17.31	20.52
EURO 3	1.35	0.60	1.00	1.38	1.71	1.95	2.33	3.00	3.81	4.72	5.76	6.92	8.22	9.64
EURO 4	1.07	0.37	0.54	0.69	0.83	0.96	1.18	1.58	2.07	2.64	3.09	3.58	4.09	4.64
EURO 5	0.11	0.07	0.10	0.13	0.16	0.18	0.23	0.30	0.40	0.50	0.59	0.68	0.78	0.89
EURO 6	0.09	0.07	0.10	0.13	0.16	0.18	0.23	0.30	0.40	0.50	0.59	0.68	0.78	0.89
Gradient [%]: - 6														
v [km/h]	**0**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**	**110**	**120**	**130**
standard	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h
Pre EURO	2.58	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	2.11	5.48
EURO 1	3.00	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	2.45	6.36
EURO 2	2.85	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	1.54	3.99
EURO 3	1.35	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.74	1.89
EURO 4	1.07	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.43	0.93
EURO 5	0.11	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.08	0.18
EURO 6	0.09	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.08	0.18
Gradient [%]: - 4														
v [km/h]	**0**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**	**110**	**120**	**130**
standard	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h
Pre EURO	2.58	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	1.81	4.09	6.57	9.53	12.97
EURO 1	3.00	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	2.11	4.75	7.63	11.07	15.07
EURO 2	2.85	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	1.32	2.98	4.78	6.94	9.44
EURO 3	1.35	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.63	1.45	2.23	3.30	4.64
EURO 4	1.07	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.39	0.71	1.12	1.76	2.60
EURO 5	0.11	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.07	0.14	0.22	0.34	0.50
EURO 6	0.09	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.07	0.14	0.22	0.34	0.50
Gradient [%]: - 2														
v [km/h]	**0**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**	**110**	**120**	**130**
standard	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h
Pre EURO	2.58	0.72	1.12	1.62	2.10	2.31	3.05	4.21	5.78	7.64	10.19	13.08	16.68	20.72
EURO 1	3.00	0.83	1.30	1.88	2.44	2.68	3.55	4.89	6.71	8.88	11.85	15.20	19.38	24.08
EURO 2	2.85	0.52	0.81	1.18	1.53	1.68	2.22	3.06	4.21	5.57	7.42	9.53	12.14	15.09
EURO 3	1.35	0.25	0.39	0.57	0.73	0.81	1.07	1.49	1.99	2.58	3.55	4.69	5.89	7.23
EURO 4	1.07	0.19	0.27	0.35	0.43	0.46	0.57	0.73	0.99	1.33	1.92	2.62	3.15	3.70
EURO 5	0.11	0.04	0.05	0.07	0.08	0.09	0.11	0.14	0.19	0.25	0.37	0.50	0.60	0.71
EURO 6	0.09	0.04	0.05	0.07	0.08	0.09	0.11	0.14	0.19	0.25	0.37	0.50	0.60	0.71

Gradient [%]: 2														
v [km/h]	**0**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**	**110**	**120**	**130**
standard	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h
Pre EURO	2.58	2.56	4.25	5.84	7.35	8.85	10.81	13.07	15.80	18.77	22.32	26.28	30.64	35.42
EURO 1	3.00	2.98	4.94	6.79	8.54	10.28	12.56	15.19	18.36	21.82	25.94	30.53	35.60	41.16
EURO 2	2.85	1.87	3.10	4.26	5.35	6.44	7.87	9.52	11.51	13.67	16.26	19.14	22.31	25.79
EURO 3	1.35	0.90	1.50	2.01	2.47	3.04	3.79	4.69	5.60	6.59	7.75	9.03	10.42	11.94
EURO 4	1.07	0.50	0.73	1.00	1.27	1.60	2.06	2.62	3.03	3.44	3.91	4.41	4.94	5.50
EURO 5	0.11	0.10	0.14	0.19	0.24	0.31	0.39	0.50	0.58	0.66	0.75	0.84	0.94	1.05
EURO 6	0.09	0.10	0.14	0.19	0.24	0.31	0.39	0.50	0.58	0.66	0.75	0.84	0.94	1.05
Gradient [%]: 4														
v [km/h]	**0**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**	**110**	**120**	**130**
standard	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h
Pre EURO	2.58	3.38	5.69	7.87	10.07	12.03	14.56	17.55	20.78	24.22	28.21	32.58	37.34	38.40
EURO 1	3.00	3.93	6.61	9.14	11.71	13.97	16.92	20.39	24.14	28.14	32.77	37.85	43.38	44.62
EURO 2	2.85	2.46	4.14	5.73	7.34	8.76	10.61	12.78	15.13	17.64	20.54	23.72	27.19	27.97
EURO 3	1.35	1.19	1.96	2.66	3.51	4.27	5.19	6.18	7.24	8.36	9.65	11.04	12.55	12.89
EURO 4	1.07	0.62	0.97	1.38	1.94	2.36	2.85	3.27	3.71	4.15	4.65	5.17	5.72	5.84
EURO 5	0.11	0.12	0.19	0.26	0.36	0.45	0.55	0.63	0.71	0.79	0.89	0.99	1.09	1.12
EURO 6	0.09	0.12	0.19	0.26	0.36	0.45	0.55	0.63	0.71	0.79	0.89	0.99	1.09	1.12
Gradient [%]: 6														
v [km/h]	**0**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**	**110**	**120**	**130**
standard	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h
Pre EURO	2.58	4.26	7.21	9.98	12.65	15.23	18.42	21.91	25.62	29.53	33.96	38.74	40.90	43.90
EURO 1	3.00	4.95	8.37	11.60	14.70	17.70	21.40	25.46	29.77	34.31	39.45	45.02	47.52	51.01
EURO 2	2.85	3.10	5.25	7.27	9.21	11.09	13.41	15.96	18.66	21.51	24.73	28.21	29.79	31.97
EURO 3	1.35	1.50	2.42	3.47	4.52	5.41	6.47	7.61	8.82	10.07	11.48	12.99	13.70	14.69
EURO 4	1.07	0.73	1.24	1.86	2.52	2.95	3.39	3.85	4.33	4.81	5.33	5.88	6.17	6.60
EURO 5	0.11	0.14	0.24	0.36	0.48	0.56	0.65	0.74	0.83	0.92	1.02	1.12	1.18	1.26
EURO 6	0.09	0.14	0.24	0.36	0.48	0.56	0.65	0.74	0.83	0.92	1.02	1.12	1.18	1.26

4.11. HGV DIESEL CO

Gradient [%]: 0														
v [km/h]	**0**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**	**110**	**120**	**130**
standard	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h
Pre EURO	78.62	92.86	99.47	109.88	119.35	126.39	134.12	145.13	163.92	190.26	221.17	246.62	265.72	282.91
EURO 1	32.49	60.80	64.49	68.62	73.88	77.07	80.55	85.63	94.01	107.74	124.37	139.56	150.84	160.83
EURO 2	18.92	40.88	43.97	49.55	54.94	58.88	63.92	71.20	79.80	87.95	95.89	104.05	110.68	115.42
EURO 3	14.04	50.69	53.47	59.60	66.03	70.68	76.90	85.76	95.89	104.65	110.93	117.24	122.15	126.22
EURO 4	6.93	25.04	33.59	42.29	49.90	56.78	65.98	80.63	98.31	107.29	113.73	120.19	125.22	129.40
EURO 5	6.99	25.25	33.68	42.38	49.91	56.72	65.89	80.61	98.48	107.47	113.92	120.40	125.44	129.62
EURO 6	5.56	20.09	24.68	29.82	34.43	38.66	44.32	53.25	64.10	69.96	74.15	78.37	81.65	84.37
Gradient [%]: - 6														
v [km/h]	**0**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**	**110**	**120**	**130**
standard	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h
Pre EURO	78.62	48.79	32.69	29.27	26.48	26.48	26.48	26.48	26.48	26.48	26.48	26.48	27.14	32.15
EURO 1	32.49	29.20	23.22	21.73	20.27	20.27	20.27	20.27	20.27	20.27	20.27	20.27	20.42	23.09
EURO 2	18.92	20.78	15.39	14.14	12.62	12.62	12.62	12.62	12.62	12.62	12.62	12.62	12.78	14.79
EURO 3	14.04	31.53	25.05	23.26	20.73	20.73	20.73	20.73	20.73	20.73	20.73	20.73	20.81	22.10
EURO 4	6.93	4.59	2.46	1.77	1.40	1.40	1.40	1.40	1.40	1.40	1.40	1.40	1.40	1.40
EURO 5	6.99	4.73	2.68	1.97	1.56	1.56	1.56	1.56	1.56	1.56	1.56	1.56	1.56	1.56
EURO 6	5.56	4.09	2.44	1.82	1.44	1.44	1.44	1.44	1.44	1.44	1.44	1.44	1.45	1.45
Gradient [%]: - 4														
v [km/h]	**0**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**	**110**	**120**	**130**
standard	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h
Pre EURO	78.62	56.00	50.84	52.88	47.65	42.97	36.06	28.51	30.23	34.21	41.74	47.64	76.43	82.04
EURO 1	32.49	33.98	29.81	30.19	28.49	27.07	24.46	21.21	21.87	23.31	27.78	30.33	36.73	51.54
EURO 2	18.92	23.15	21.40	21.90	20.02	18.26	15.77	13.33	13.78	14.89	17.21	19.79	26.10	34.11
EURO 3	14.04	31.64	32.10	32.10	30.00	28.31	25.62	21.96	22.53	23.96	26.40	29.08	34.95	42.24
EURO 4	6.93	7.43	5.69	5.46	4.14	2.75	2.00	1.56	1.53	1.63	1.80	1.98	2.38	2.87
EURO 5	6.99	7.63	5.64	5.44	4.23	2.96	2.20	1.74	1.71	1.82	2.01	2.21	2.66	3.21
EURO 6	5.56	6.64	4.63	4.49	3.59	2.67	2.02	1.61	1.59	1.70	1.87	2.06	2.47	2.99
Gradient [%]: - 2														
v [km/h]	**0**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**	**110**	**120**	**130**
standard	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h
Pre EURO	78.62	78.59	75.13	89.49	92.15	90.90	84.35	78.95	86.77	97.21	113.07	130.49	151.31	176.75
EURO 1	32.49	51.95	49.74	58.63	59.89	58.95	55.50	50.02	53.59	61.47	68.80	77.84	87.55	98.99
EURO 2	18.92	33.68	31.91	38.90	39.91	39.12	36.53	33.56	36.65	42.35	48.93	57.80	66.88	78.30
EURO 3	14.04	44.16	42.40	49.01	49.78	48.96	47.61	43.23	46.01	50.05	58.40	68.48	78.37	90.65
EURO 4	6.93	17.17	17.73	22.90	23.45	22.13	19.57	17.40	18.69	17.52	20.44	23.97	27.43	31.73
EURO 5	6.99	17.27	17.73	22.99	23.55	22.12	19.30	16.61	18.39	17.52	20.44	23.97	27.43	31.73
EURO 6	5.56	13.94	14.04	18.12	18.55	17.35	14.80	12.32	13.61	13.51	15.77	18.49	21.16	24.48

Gradient [%]: 2														
v [km/h]	**0**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**	**110**	**120**	**130**
standard	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h
Pre EURO	78.62	104.66	121.24	139.84	161.20	187.17	214.87	240.28	270.41	301.71	332.91	361.94	391.16	419.86
EURO 1	32.49	66.92	75.13	83.71	94.13	107.94	123.16	137.48	154.03	171.89	189.65	206.13	222.70	238.92
EURO 2	18.92	46.89	57.27	69.02	79.34	88.33	95.81	102.42	109.57	118.37	128.01	137.60	147.72	157.76
EURO 3	14.04	56.68	69.24	83.62	95.75	105.02	111.25	116.34	121.70	128.68	137.14	146.83	156.58	166.80
EURO 4	6.93	36.62	55.07	73.89	93.57	112.97	129.02	142.96	143.45	151.68	161.64	173.06	184.56	196.61
EURO 5	6.99	36.67	55.12	74.00	93.70	113.31	129.53	144.83	145.75	154.12	164.24	175.85	187.53	199.77
EURO 6	5.56	26.59	37.74	49.70	61.56	73.06	80.46	86.18	92.26	97.55	103.96	111.31	118.70	126.45
Gradient [%]: 4														
v [km/h]	**0**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**	**110**	**120**	**130**
standard	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h
Pre EURO	78.62	119.28	147.27	182.21	218.90	253.88	290.67	330.52	373.52	416.65	459.47	501.82	543.60	585.27
EURO 1	32.49	74.08	87.60	105.65	126.01	145.50	165.96	188.26	212.62	236.97	261.24	285.19	308.87	332.50
EURO 2	18.92	55.70	73.69	86.98	97.19	105.91	115.51	126.27	139.75	154.06	168.84	183.65	198.28	212.72
EURO 3	14.04	67.22	89.54	103.64	112.36	118.98	126.86	135.75	148.07	161.85	177.00	192.14	207.10	221.78
EURO 4	6.93	52.20	82.69	109.10	131.34	143.19	146.40	147.40	152.76	163.47	178.77	194.06	209.17	224.00
EURO 5	6.99	52.17	82.89	109.45	131.89	144.91	148.52	148.93	153.75	161.85	177.00	192.14	207.10	221.78
EURO 6	5.56	35.76	55.23	71.07	81.54	88.93	97.26	106.75	119.20	130.29	142.49	154.68	166.72	178.54
Gradient [%]: 6														
v [km/h]	**0**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**	**110**	**120**	**130**
standard	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h
Pre EURO	78.62	132.55	173.66	222.19	269.26	321.05	373.62	428.27	486.25	544.02	601.32	658.43	715.05	772.44
EURO 1	32.49	80.39	101.27	128.23	154.56	183.20	212.68	243.29	276.33	309.02	341.68	373.94	406.08	438.32
EURO 2	18.92	64.53	84.29	98.26	110.56	124.28	139.83	156.43	176.57	196.48	216.57	236.43	256.37	276.48
EURO 3	14.04	78.24	101.07	113.22	123.05	134.87	148.86	164.13	184.12	204.72	225.42	245.84	266.01	286.79
EURO 4	6.93	66.81	103.69	133.61	146.36	149.96	155.64	164.23	178.73	198.73	218.81	238.64	258.21	278.39
EURO 5	6.99	66.85	104.03	134.21	147.95	151.75	156.80	163.77	176.96	196.76	216.64	236.27	255.65	275.63
EURO 6	5.56	45.15	67.85	82.49	92.98	105.12	119.28	130.56	146.96	163.41	179.92	196.22	212.32	228.91

4.12. HGV DIESEL NO_X

Gradient [%]: 0														
v [km/h]	**0**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**	**110**	**120**	**130**
standard	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h
Pre EURO	119.60	248.86	289.35	359.73	423.80	473.26	531.59	624.38	761.50	934.84	1150.83	1350.13	1492.85	1607.31
EURO 1	99.41	169.02	197.02	230.12	283.82	315.42	352.87	412.74	496.93	604.24	736.65	863.04	955.36	1032.92
EURO 2	97.84	199.64	232.28	280.20	322.93	355.06	397.54	460.14	543.35	645.02	766.46	902.04	1011.43	1082.29
EURO 3	98.52	168.50	196.08	233.29	264.36	286.89	317.69	361.96	419.90	495.24	587.84	691.84	777.85	833.29
EURO 4	99.51	170.18	194.12	226.29	229.99	220.90	219.21	213.56	218.35	237.72	282.16	332.08	373.37	399.98
EURO 5	78.82	134.80	137.25	151.64	158.62	157.79	158.85	141.16	125.97	128.76	152.84	179.88	202.24	216.66
EURO 6	25.62	33.70	25.49	23.33	26.44	28.69	31.77	36.20	41.99	49.52	58.78	69.18	77.79	83.33
Gradient [%]: - 6														
v [km/h]	**0**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**	**110**	**120**	**130**
standard	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h
Pre EURO	119.60	70.33	43.13	38.20	35.05	35.05	35.05	35.05	35.05	35.05	35.05	35.05	36.29	50.01
EURO 1	99.41	46.69	29.54	26.16	23.43	23.43	23.43	23.43	23.43	23.43	23.43	23.43	23.81	30.51
EURO 2	97.84	62.99	41.07	36.66	31.70	31.70	31.70	31.70	31.70	31.70	31.70	31.70	32.28	43.80
EURO 3	98.52	51.19	33.60	29.89	25.31	25.31	25.31	25.31	25.31	25.31	25.31	25.31	25.49	28.80
EURO 4	99.51	17.92	7.82	5.08	4.30	4.30	4.30	4.30	4.30	4.30	4.30	4.30	4.33	4.90
EURO 5	78.82	15.87	6.91	4.19	3.54	3.54	3.54	3.54	3.54	3.54	3.54	3.54	3.57	4.03
EURO 6	25.62	7.17	4.03	2.69	2.28	2.28	2.28	2.28	2.28	2.28	2.28	2.28	2.29	2.59
Gradient [%]: - 4														
v [km/h]	**0**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**	**110**	**120**	**130**
standard	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h
Pre EURO	119.60	85.34	74.46	77.80	68.74	59.70	45.58	36.72	38.88	44.29	60.66	88.72	162.97	245.07
EURO 1	99.41	60.28	49.06	51.18	45.46	40.01	31.50	24.86	26.21	29.61	40.66	55.11	90.16	162.13
EURO 2	97.84	75.74	65.77	68.80	61.26	53.36	42.33	33.78	35.33	39.39	50.17	68.01	107.71	164.25
EURO 3	98.52	61.17	53.14	55.33	49.38	43.18	34.46	27.22	28.30	31.31	37.91	52.07	83.43	124.35
EURO 4	99.51	34.87	28.16	27.66	16.30	8.64	5.86	4.63	4.81	5.32	6.44	8.85	14.18	21.14
EURO 5	78.82	31.81	24.97	24.90	14.32	7.77	4.82	3.81	3.96	4.38	5.31	7.29	11.68	17.41
EURO 6	25.62	12.23	9.03	9.41	6.91	4.75	3.10	2.45	2.55	2.82	3.41	4.69	7.51	11.19
Gradient [%]: - 2														
v [km/h]	**0**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**	**110**	**120**	**130**
standard	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h
Pre EURO	119.60	169.74	154.44	228.41	242.47	234.52	204.01	213.33	222.65	280.32	381.14	504.77	662.32	826.34
EURO 1	99.41	119.22	108.91	155.49	164.18	159.01	145.00	145.93	146.85	190.07	245.03	322.75	417.12	517.03
EURO 2	97.84	140.08	128.12	179.83	189.09	183.19	167.14	169.10	171.07	218.54	272.02	351.83	444.38	571.25
EURO 3	98.52	114.74	104.92	149.34	157.73	152.35	138.38	139.83	141.28	167.35	215.53	273.89	342.43	432.34
EURO 4	99.51	96.38	95.48	146.35	154.58	144.73	117.62	113.26	114.43	135.55	174.58	221.85	277.37	350.19
EURO 5	78.82	84.91	78.69	104.54	94.64	83.79	73.34	69.91	63.57	66.94	86.21	109.56	136.97	172.94
EURO 6	25.62	25.24	26.23	37.33	37.86	38.09	30.44	30.76	31.08	36.82	43.11	49.30	54.79	60.53

Gradient [%]: 2														
v [km/h]	**0**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**	**110**	**120**	**130**
standard	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h
Pre EURO	119.60	323.84	439.31	585.52	742.83	922.34	1113.26	1304.18	1529.38	1752.42	1967.27	2153.22	2340.87	2522.76
EURO 1	99.41	219.43	296.35	392.12	493.07	606.93	727.42	846.80	987.29	1130.74	1265.93	1388.34	1507.29	1624.46
EURO 2	97.84	257.23	341.65	441.31	542.35	652.45	765.54	873.90	999.05	1131.54	1261.59	1380.55	1497.37	1610.58
EURO 3	98.52	215.73	279.79	351.22	424.02	507.03	594.66	678.34	774.34	876.99	979.33	1079.29	1163.63	1251.72
EURO 4	99.51	211.42	212.64	221.27	224.73	243.37	285.44	325.60	371.68	420.95	470.08	518.06	558.54	600.83
EURO 5	78.82	161.80	165.08	147.51	169.61	177.46	178.40	176.37	193.59	219.25	244.83	269.82	290.91	312.93
EURO 6	25.62	25.89	33.58	35.12	42.40	50.70	59.47	67.83	77.43	87.70	97.93	107.93	116.36	125.17
Gradient [%]: 4														
v [km/h]	**0**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**	**110**	**120**	**130**
standard	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h
Pre EURO	119.60	423.55	643.95	890.81	1147.75	1403.23	1671.94	1959.75	2250.20	2527.84	2799.64	3067.96	3334.01	3597.30
EURO 1	99.41	285.64	431.45	589.08	751.89	912.54	1081.18	1262.76	1448.15	1626.63	1800.78	1972.71	2142.83	2311.75
EURO 2	97.84	329.19	484.50	636.31	788.72	934.00	1085.46	1250.01	1424.45	1595.73	1762.99	1927.96	2091.66	2253.49
EURO 3	98.52	270.15	383.28	496.02	614.10	726.89	843.61	970.97	1106.41	1239.89	1369.82	1498.33	1625.34	1750.96
EURO 4	99.51	210.72	218.47	238.09	294.77	348.91	404.93	475.78	542.14	607.55	671.21	734.18	796.42	857.97
EURO 5	78.82	170.19	172.47	208.33	214.93	218.07	219.34	242.74	276.60	309.97	342.46	374.58	406.33	437.74
EURO 6	25.62	27.01	38.33	49.60	61.41	72.69	84.36	97.10	110.64	123.99	136.98	149.83	162.53	175.10
Gradient [%]: 6														
v [km/h]	**0**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**	**110**	**120**	**130**
standard	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h
Pre EURO	119.60	524.25	830.64	1175.66	1517.41	1880.74	2246.71	2615.19	2984.33	3350.10	3712.71	4073.02	4431.57	4789.59
EURO 1	99.41	352.77	552.02	770.73	986.13	1214.99	1447.30	1681.80	1918.41	2152.33	2384.95	2615.56	2845.14	3074.35
EURO 2	97.84	402.60	602.89	806.61	1002.14	1207.49	1420.61	1638.31	1865.00	2088.56	2311.18	2532.19	2752.29	2972.50
EURO 3	98.52	324.27	471.63	628.78	780.48	939.37	1104.37	1272.93	1448.30	1622.55	1795.56	1967.36	2137.87	2308.92
EURO 4	99.51	210.78	231.10	301.82	382.44	460.29	541.14	623.73	709.67	795.05	879.82	964.00	1047.56	1131.37
EURO 5	78.82	149.17	212.23	220.07	234.14	234.84	276.09	318.23	362.08	405.64	448.89	491.84	534.47	577.23
EURO 6	25.62	22.70	37.73	50.30	70.24	93.94	110.44	127.29	144.83	162.26	179.56	196.74	213.79	230.89

4.13. HGV DIESEL PM

Gradient [%]: 0														
v [km/h]	**0**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**	**110**	**120**	**130**
standard	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h
Pre EURO	14.70	16.81	18.21	20.33	22.11	23.41	24.84	27.03	30.64	35.74	41.78	47.21	51.21	54.62
EURO 1	11.05	11.09	11.91	12.77	14.14	14.70	15.30	16.18	17.88	21.17	25.35	29.31	32.21	34.69
EURO 2	1.81	3.72	4.21	4.98	5.68	6.20	6.88	7.90	9.22	10.77	12.56	14.51	16.06	17.09
EURO 3	1.72	5.65	5.81	6.25	6.72	7.05	7.48	8.08	8.80	9.62	10.49	11.39	12.09	12.61
EURO 4	0.86	0.89	1.19	1.58	1.80	1.90	1.98	2.08	2.29	2.54	2.81	3.10	3.33	3.49
EURO 5	0.86	0.90	1.20	1.60	1.83	1.93	2.01	2.11	2.32	2.56	2.84	3.12	3.35	3.58
EURO 6	0.86	0.27	0.36	0.48	0.55	0.59	0.61	0.64	0.70	0.77	0.86	0.94	1.01	1.09
Gradient [%]: - 6														
v [km/h]	**0**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**	**110**	**120**	**130**
standard	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h
Pre EURO	14.70	7.70	5.01	4.38	3.84	3.84	3.84	3.84	3.84	3.84	3.84	3.84	3.92	4.80
EURO 1	11.05	6.35	4.00	3.52	3.10	3.10	3.10	3.10	3.10	3.10	3.10	3.10	3.15	3.83
EURO 2	1.81	1.27	1.10	1.07	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.01	1.18
EURO 3	1.72	4.97	4.70	4.57	4.36	4.36	4.36	4.36	4.36	4.36	4.36	4.36	4.36	4.41
EURO 4	0.86	1.38	1.30	1.28	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.27
EURO 5	0.86	1.40	1.33	1.31	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.29
EURO 6	0.86	0.43	0.40	0.40	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39
Gradient [%]: - 4														
v [km/h]	**0**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**	**110**	**120**	**130**
standard	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h
Pre EURO	14.70	8.32	7.86	7.97	7.33	6.96	6.25	4.30	4.66	5.54	7.30	7.72	13.06	15.04
EURO 1	11.05	8.25	6.67	7.06	6.21	5.45	4.39	3.35	3.55	4.05	5.16	5.87	7.51	10.36
EURO 2	1.81	1.47	1.30	1.37	1.31	1.23	1.16	1.05	1.07	1.11	1.31	1.53	2.07	3.16
EURO 3	1.72	4.54	4.97	4.89	4.83	4.83	4.78	4.49	4.54	4.64	4.78	4.86	4.95	5.32
EURO 4	0.86	1.28	1.38	1.38	1.35	1.33	1.30	1.26	1.27	1.28	1.29	1.24	1.21	1.52
EURO 5	0.86	1.18	1.41	1.40	1.38	1.36	1.33	1.29	1.29	1.31	1.32	1.24	1.20	1.41
EURO 6	0.86	0.36	0.43	0.43	0.42	0.41	0.40	0.39	0.39	0.40	0.40	0.37	0.36	0.43
Gradient [%]: - 2														
v [km/h]	**0**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**	**110**	**120**	**130**
standard	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h
Pre EURO	14.70	13.06	12.34	16.00	16.58	16.28	15.08	13.85	15.41	17.65	20.64	24.10	28.23	32.90
EURO 1	11.05	10.48	10.18	11.43	11.65	11.51	11.17	10.02	10.72	12.36	13.25	15.03	17.04	19.45
EURO 2	1.81	2.70	2.48	3.41	3.56	3.46	3.17	2.73	3.18	4.00	4.86	6.13	7.54	9.51
EURO 3	1.72	5.28	5.17	5.56	5.60	5.56	5.57	5.27	5.42	5.65	6.19	6.94	7.68	8.69
EURO 4	0.86	0.63	0.63	0.69	0.78	0.77	1.03	0.93	1.03	1.25	1.31	1.60	1.89	2.24
EURO 5	0.86	0.65	0.65	0.70	0.78	0.78	0.96	1.13	1.04	1.24	1.32	1.56	1.89	2.21
EURO 6	0.86	0.20	0.20	0.21	0.24	0.24	0.30	0.34	0.31	0.37	0.48	0.45	0.56	0.65

Gradient [%]: 2														
v [km/h]	**0**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**	**110**	**120**	**130**
standard	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h
Pre EURO	14.70	19.28	22.52	26.07	30.23	35.33	40.73	45.89	51.96	58.33	64.61	70.29	76.01	81.62
EURO 1	11.05	12.92	14.36	15.84	18.00	21.26	25.07	28.79	33.14	37.67	41.99	45.92	49.77	53.56
EURO 2	1.81	4.61	5.99	7.60	9.19	10.87	12.54	14.10	15.88	17.79	19.70	21.47	23.23	24.95
EURO 3	1.72	6.04	6.95	7.93	8.83	9.72	10.54	11.27	12.05	12.96	13.97	15.07	16.11	17.21
EURO 4	0.86	1.39	1.86	2.08	2.31	2.59	2.85	3.08	3.33	3.61	3.92	4.24	4.54	4.85
EURO 5	0.86	1.41	1.89	2.11	2.35	2.62	2.88	3.12	3.37	3.65	3.95	4.28	4.58	4.90
EURO 6	0.86	0.43	0.58	0.64	0.71	0.80	0.88	0.95	1.02	1.11	1.20	1.30	1.39	1.49
Gradient [%]: 4														
v [km/h]	**0**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**	**110**	**120**	**130**
standard	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h
Pre EURO	14.70	22.10	27.54	34.39	41.64	48.61	56.02	64.04	72.60	81.07	89.43	97.72	105.88	114.03
EURO 1	11.05	14.18	16.62	20.72	25.83	30.85	36.11	41.80	47.72	53.47	59.11	64.68	70.19	75.67
EURO 2	1.81	5.78	8.28	10.62	12.87	14.95	17.14	19.50	22.08	24.64	27.17	29.68	32.17	34.62
EURO 3	1.72	6.80	8.34	9.59	10.70	11.65	12.69	13.84	15.26	16.78	18.40	20.01	21.61	23.17
EURO 4	0.86	1.81	2.17	2.55	2.90	3.21	3.53	3.89	4.31	4.75	5.21	5.67	6.13	6.58
EURO 5	0.86	1.85	2.21	2.59	2.94	3.25	3.58	3.93	4.35	4.79	5.26	5.72	6.18	6.65
EURO 6	0.86	0.56	0.67	0.79	0.90	0.99	1.09	1.20	1.32	1.46	1.60	1.74	1.88	2.02
Gradient [%]: 6														
v [km/h]	**0**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**	**110**	**120**	**130**
standard	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h	g/h
Pre EURO	14.70	24.65	32.71	42.38	51.74	62.07	72.57	83.35	94.71	106.00	117.20	128.36	139.42	150.62
EURO 1	11.05	15.27	19.68	26.42	33.16	40.36	47.70	55.15	62.82	70.41	77.96	85.45	92.89	100.34
EURO 2	1.81	6.97	10.11	13.12	15.94	18.92	22.03	25.24	28.67	32.06	35.45	38.81	42.16	45.52
EURO 3	1.72	7.57	9.34	10.83	12.17	13.66	15.31	17.07	19.22	21.41	23.61	25.77	27.92	30.11
EURO 4	0.86	2.01	2.47	2.94	3.36	3.82	4.31	4.84	5.46	6.09	6.71	7.33	7.95	8.56
EURO 5	0.86	2.05	2.51	2.99	3.41	3.86	4.36	4.88	5.51	6.14	6.77	7.39	8.01	8.64
EURO 6	0.86	0.62	0.76	0.91	1.04	1.18	1.33	1.49	1.68	1.88	2.06	2.26	2.45	2.64

4.14. INFLUENCE OF DEGRADATION OF EXHAUST GAS AFTERTREATMENT SYSTEMS

The emission factors for the single vehicle categories and emission standard classes given in this section are valid for vehicles on the road in good operating condition. Since exhaust gas after-treatment systems degrade with vehicle age, the tailpipe emissions tend to rise. The following tables contain the correction factors which should be applied when using the base emission factors given in *section 3*.

TABLE 78 – DEGRADATION FACTOR FOR PC AND LDV GASOLINE				
CO	**Years after implementation of the standard in a country**			
Emission standard	1	5	10	>= 15
Euro0	1	1	1	1
Euro1	1	1.5	2.5	2.6
Euro2	1	1.4	1.8	2.2
Euro3	1	1.3	1.8	2.0
Euro4	1	1.3	1.8	2.0
NO_x	**Years after implementation of the standard in a country**			
Emission standard	1	5	10	>= 15
Euro0	1	1	1	1
Euro1	1	1.9	3.0	3.4
Euro2	1	1.5	1.9	2.0
Euro3	1	1.2	1.3	1.4
Euro4	1	1.2	1.3	1.4

Degradation factors should be applied only to gasoline cars with catalytic converters. For Euro 5 and Euro 6 vehicles, no data is currently available.

4.15. INFLUENCE OF COLD START

Vehicles operating in road tunnels normally operate under hot stabilized engine conditions. The emission factors given in this report describes the emission behaviour under these operating conditions. However, for certain installations, it might be necessary to consider the emission behaviour of vehicles under cold-start conditions. Cold-start emissions strongly exceed the emission quantities for hot stabilized conditions. Various emission databases like *"emission factor handbook"* [6] or Mobile [7] provide factors on additional emissions to take cold start into account.